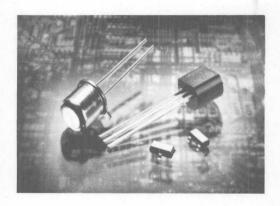


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This publication presents technical information for the several product families that comprise the Motorola small-signal semiconductor line. The families includes bipolar, field-effect transistors, and diodes. These are available in a variety of packages; metal can, plastic, and surface mount. Complete device specifications and typical performance curves are given on individual data sheets, which are grouped by the various families.

A quick comparison of performance characteristics is presented in the easy-to-use selector guides in the first section. The tables will assist in the selection of the proper transistor for a specific application.

Separate sections are included to describe package outline drawings, and to clarify the

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MMBT5088	3-113	MMBZ5236B
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MMBT6427	3-116	MMBZ5241B
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MMBT6517	3-118	MMBZ5244B
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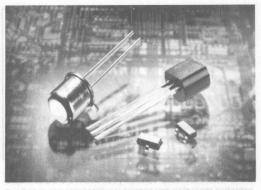
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The following selector guides highlight semiconductors that are the most popular and have a history of high usage for the most applications.

These selector guides cover a wide range of small signal plastic and metal can semiconductors.

A large selection of encapsulated plastic transistors, FETs and diodes are available for surface mount and insertion assembly technology. Plastic packages include TO-226AA, TO-226AE 1 Watt and SOT-23. Plastic multiples are available in 14-pin and 16-pin dual-in-line packages for insertion applications: SO-8, SO-14 and SO-16 for surface mount applications.

Metal can and ceramic packages are available for applications requiring higher power dissipation or having hermetic requirements. TO-18, TO-205AD, TO-46, TO-52 and TO-72 packages contain discrete devices. There is a variety of ceramic dip and flatpacks available for multiple transistors, FETs and diodes.

Devices which are JAN, JANTX, JTXV or CECC qualified are noted in the individual selector guides or in the Hi-Rel and Military Section of this selector guide.

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Plastic-Encapsulated

Motorola's small-signal TO-226 plastic transistors encompass hundreds of devices with a wide variety of characteristics for general purpose, amplifier and switching applications. The popular high-volume package combines proven reliability, performance, economy and convenience to provide the perfect solution for industrial and consumer design problems. All devices are laser marked for ease of identification and shipped in antistatic containers, as part of Motorola's ongoing practice of maintaining the highest standards of quality and reliability.

In addition to the standard devices listed in the following tables, Motorola also offers special electrical selections of

these devices. Please contact your Motorola Sales Representative regarding any special requirements you may have. In each of the following tables, the major specifications

of the transistors or diodes are given for easy comparison. All transistors are available in the radial or axial tape and reel formats. Lead forming to fit TO-5 or TO-18 sockets is also available.

TABLE 1. General-Purpose Amplifier Transistors

The general-purpose transistors are designed for small-signal amplification from dc to low radio frequencies. They are also useful as oscillators and general purpose switches.

NPN	PNP	Pin Out	V(BR)CEO Volts Min	fT @ Ic MHZ Min	mA	alle and	I _C mA Max	Min	h _{FE} @ I _C	mA mA	NF Max dB
O-226AA		Dindoc	lead lone ve	NOS C		yte	nev s ai en	wices. The	discrete de	matrico sepa	O-72 pack
MPS8099	MPS8599	EBC	80	150	10	-516	200	100	300	ann one on	01116)90 1
MPSA06	MPSA56	EBC	80	100	10		50	50		100	F 21 3 7 1810
BC546	BC556	CBE	65	150	10	bei	100	120	450	2	10
BC546A	BC556A	CBE	65	150	10	leit	100	120	220	2	10
BC546B	BC556B	CBE	65	150	10		100	180	450	TO 402 387	10
MPS8098	MPS8598	EBC	60	150	10		200	100	300	1	_
MPSA05	MPSA55	EBC	60	100	10	. 1	500	50	_	100	_
MPS651	MPS751	EBC	60	75	50		2000	40	10 An	2000	_
BC182	BC212	CBE	50	200	10		100	120	460	2	10
BC237	BC307	CBE	45	150	10		100	120	460	2	10
BC239	BC309	CBE	45	150	10	306	100	180	800	8 2	10
BC547	BC557	CBE	45	150	10	- 70	100	120	450	Heritali 2 georg	109
BC547A	BC557A	CBE	45	150	10	0.0	100	120	220	A 38 2	10
BC547B	BC557B	CBE	45	150	10	10	100	180	450	2 2	10
BC547C	BC557C	CBE	45	150	10	0	100	380	800	2	10
BC317	BC320	CBE	45	250	10	191	150	110	450	2	10
2N3904	2N3906	EBC	40	300	10	25	200	100	300	10	5
2N4401	2N4403	EBC	40	250	20	100	600	100	300	150	0-41350
2N3903	2N3905	EBC	40	250	10	- 0	200	50	150	100	6
2N4400	2N4402	EBC	40	200	20	8	600	50	150	150	ms 3A
MPSA20	MPSA70	EBC	40	125	5	- 8	100	40	400	stuff 5 been	e-rojH
MPS650	MPS750	EBC	40	75	50	â	2000	40		2000	equer <u>ia</u>
MPS6531	MPS6534	EBC	40	390*	50	-31	600	10	120	100	Mer. had
MPS2222	MPS2907	EBC	30	250	20	7	600	100	300	150	Telecon
2N4123	2N4125	EBC	30	250	10	100	200	50	150	2 2	testo ==
MPS3704	MPS3702	EBC	30	100	50	-	600	100	300	50	200 1995
MPS6513	MPS6517	EBC	30	330*	10	- 4	100	90	180	2	7537-UT
BC548	BC558	CBE	30	300*	10	29	100	120	300	2	10
BC548A	BC558A	CBE	30	300*	10	8	100	120	220	2	10
BC548B	BC558B	CBE	30	300*	10		100	180	450	2 2000	10
BC548C	BC558C	CBE	30	300	10	. 6	100	380	800	2	10
2N4124	2N4126	EBC	25	300	10	51	200	120	360	2 100	8-rtniH
MPS6514	MPS6518	EBC	25	480*	10		100	150	300	dell 2008li	W-digital
MPS6515	MPS6519	EBC	25	480	10	63	100	250	500	2	legen /
MPS5172		EBC	25	120*	5	7	100	100	500	A V109U0	Park did
MPS6560	MPS6562	EBC	25	60	10	EF	500	50	200	600	Single -
MPS6601	MPS6551	EBC	25	100	50	77.1	1000	30	150	1000	Deleterate
BC238	BC308	CBE	25	150	10	21	100	120	800	2	10

TABLE 2. Low-Noise and Good hee Linearity anotatenes Traffitem A trions 3-right A 3 181AT

These devices are designed to use on applications where good her linearity and low noise characteristics are required: Instrumentation, Hi-Fi Preamplifier.

				preset.			Wen all				
(sHM) NPN	PNP	And Pin Out	× V	(BR)CI Volts	EO	Min	Max	IC mA	V _T mV Typ	NF dB Max	f _T Typ MHz
TO-226AA		one I	nne	- 1	ner	nna					
-015	MPS4249	EBC	009	60	001	100	625 -	10	- 380	3 60 6	100
250.200	2N5087	DI EBC	-	60	05	250	- 828	10	-180	2 08	40
250/200	MPS425A	Of EBC	-	60	7.0	250	- 880	1008	-80	2 08	250
250(260-	2N5086	0 EBC	4-	50	70	150	825 -	10	290	3	40
BC239	BC309	OO! CBE	000	45	08	120	800	2	9.5	2	240
BC414	BC416	CBE	400	45	03	180	800	2 08	8	2.5	250
BC550	BC560	CBE	ARD	45	08	180	800	2 03	8	2.5	250
BC550B	BC560B	OO CBE	+	45	93	180	460	2 08	8	2.5	250
BC550C	BC560C	CBE	+	45	50	380	800	2 08	8	2.5	250
BC651	-2	OUT EBC	+	45	52	380	1400	2 08	-	965 61 3 FM	300
MPSA18	-	EBC	001	45	108	500	- 898	2 08	7		160
-30S	MPS4250	EBC	0.05	40	60	250	-825	1008	003	2	250
BC413	BC415	CBE	-	30	81	180	800	2 0	8	2.5	250
BC549	BC559	DOS CBE	-	30	00	180	800	2	8	2.5	250
BC549B	BC559B	CBE		30		180	800	2	8	2.5	250
BC459C	BC459C	CBE	3-12	30		380	800	2	8	2.5	250
BC650	_	EBC		30		380	1400	2	_		300
2N4123	2N4125	EBC		30		50	150	2	nA Tonot	6	300
2N5088	_	EBC		30		350	-19/2019/11	2	nes Affins	3	150
2N4124	2N4126	EBC	tubes,	25	SAN P	120	360	2	eb s ue moi	anni 5 pallov	350
2N5089	er of dec m atri	EBC	918 88	25	seer	450	ilety lo w colk	dialen 2. Villous	volta go cap	figirl p.2 luper	150
_	MPS6523	EBC		25		300	-	2	_	3	340*

1 V_T: Total input Noise Voltage (see BC413/BC414 and BC415/BC416 Data Sheets) at R_S = 2 k Ω , I_C = 200 μ A, V_{CE} = 5 Volts. f = 30 Hz to 15 kHz. 3 At V_{CE} = 1 V. "S" version. (§) @ 1 kHz.

TABLE 3. Darlington Transistors

Darlington amplifiers are cascade transistors used in applications requiring very high gain and input impedance. These devices have monolithic construction.

NPN	PNP	Pin Out	V _{(BR)CEO} Volts	I _C Max	h _i Min	E Max	I _C mA	Volts Max	V _{CE(sat)} I _C mA	I _B	f _T Min	lc
ГО-226АА	60	2	20	\$.0	Q.r		it.	0.5	260	SBC		98.392
MPSA29	-	EBC	100	500	10K	- 1	100	1.4	100	0.1	125	10
BC372	170	EBC	100	1000	25K	160K	100	e.s 1	250	0.25	100	100
MPSA28	100	EBC	80	500	10K		100	8.01.4	100	0.1	125	10
BC373	751	EBC	80	1000	25K	160K	100	201	250	0.25	100	10
MPSA27	MPSA77	EBC	60	500	10K	-	100	1.5	100	0.1	125	10
BC618		CBE	55	1000	10K	50K	200	1.1	200	0.2	150	50
MPSA26	MPSA76	EBC	50	500	10K	_	100	1.5	100	0.1	125	10
MPSA25	MPSA75	EBC	40 .	500	10K	-	100	1.5	100	0.1	125	10
BC617	- Table	CBE	40	1000	20K	70K	200	1.1	200	0.2	150	50
2N6427	45	EBC	40	500	20K	200K	100	1.5	500	0.5	125	10
2N6426	707	EBC	40	500	30K	300K	100	1.5	500	0.5	125	10
MPSA14	MPSA64	EBC	30	500	20K	- 3	100	1.5	100	0.1	125	10
MPSA13	MPSA63	EBC	30	500	10K	- Y	100	1.5	100	0.1	125	10
BC517	154	CBE	30	400	30K	1	20	1	100	0.1	125	10
-01	MPSD54	EBC	25	300	1K	- 1	100	0.0 1	100	0.1	100	10
MPSA12	MPSA62	EBC	20	500	20K		10	1	10	0.01	125	10
O-226AE (1 WATT)											
MPSW6725	_	EBC	50	1000	25K	_	200	1.5	1000	2	100	20
MPSW6724	_	EBC	40	1000	25K	_	200	1.5	1000	2	100	20
MPSW45	-0	EBC	40	1000	25K	_	200	1.5	1000	2	100	20
MPSW14	MPSW64	EBC	30	1000	20K	- 5	100	1.5	100	0.1	125	10
MPSW13	MPSW63	EBC	30	1000	10K	_	100	1.5	100	0.1	125	10

BIPOLAR DEVICES — PLASTIC-ENCAPSULATED (continued) TRAJE — 230 NEG RAJEGUS

TABLE 4. High-Current Amplifier Transistors villability and bood bits selon-would all SAT

Useful in Low Power Audio Output Stages and Medium Current Switches.

NPN	PNP	Pin Out	V _(BR) CEO Volts	P _D mW 25°C Amb	I _C (mA) Cont	h _F	E Max	@ Ic (mA)	V _{CE} (Volts)	f _T Typical
O-226AA	XISTER	वस्त	Am	XOV	4035	035	aV	TULU	4614	1.99
BC337	BC327	CBE	45	625	800	100	600	100	1	210
BC338	BC328	CBE	25	625	800	100	600	100	0453424M	210
BC445	BC446	CBE	60	625	300	70	-	10	5	250/2001
BC447	BC448	CBE	80	625	300	70	_	10	5	250/2001
BC449	BC450	CBE	100	625	300	70	-	10	880858	250/2001
BC485	BC486	CBE	45	625	1000	60	400	100	2	200/1501
BC487	BC488	CBE	60	625	1000	60	400	100	2	200/1501
BC489	BC490	CBE	80	625	1000	60	400	100	2	200/1501
MPSA05	MPSA55	EBC	60	625	500	50		100	808838	150/1751
MPSA06	MPSA56	EBC	80	625	500	50	-	100	200033	150/1751
MPS8099	MPS8599	EBC	80	625	500	75	1	100	5	2001
2N4409		EBC	50	625	250	60	400	10	1	200
2N4410	- s	EBC	80	625	250	60	400	10	(4623/28)	200
MPS650	MPS750	EBC	40	625	2000	75	1	1000	2	100
	2.5		2	008	180	40	-	2000	2	BC548
THE .		-		0.0118	1007			409173	E40301-01-751	

¹Relevant to PNP.

TABLE 5. High-Voltage Amplifier Transistors

These high-voltage transistors are designed for driving neon bulbs and Nixie* indicator tubes, for direct line operation, and for other applications requiring high-voltage capability at relatively low collector current. These devices are listed in order of decreasing breakdown voltage (V_(BR)CEO).

Device Type	Pin Out	V(BR)CEO Volts Min	I _C Max mA	hFE (@ IC mA	V _F Volts Max	VCE(sat) @ IC mA	I _B mA	f _T MHz Min	@ I _C mA
IPN — TO	-226AA							553		
BF844	EBC	400	0.5	40	30	0.5	10	หลาโาสดร์	50	10
MPSA44	EBC	400	0.3	40	100	0.75	50	5	20	10
BF845	EBC	350	0.5	40	30	0.5	10	1	50	10
MPSA45	EBC	350	0.3	50	100	0.75	50	5	20	10
2N6517	EBC	350	05	30	30	0.2	10	1	40	10
BF393	EBC	300	0.5	40	10	0.2	20	2 2	50	10
MPSA42	EBC	300	0.5	40	30	0.5	20	2	50	10
2N6517	EBC	300	0.5	45	30	0.3	10	1	40	10
BF392	EBC	250	0.5	40	10	0.2	20	2	50	10
2N6515	EBC	250	0.5	50	30	0.3	10	1	40	10
BF391	EBC	200	0.5	40	10	0.2	20	2	50	10
MPSA43	EBC	200	0.5	40 ×08	10	0.4	20	2	50	10
2N5551	EBC	160	0.6	80	10	0.15	10	084	100	10
2N5550	EBC	140	0.6	60	10	0.15	10	089	100	10
MPSL01	EBC	100	0.15	20	30	0.2	10	084	40	10
IPN — TO	-226AE (1 WATT)	1.5	30r —	16K	500	08	269	MPSAZE	MPSALG
BDC05	ECB	300	0.5	40	25	2 2	20	2	60	10
MPS6735	EBC	300	0.3	40	10	2	20	2	50	10
MPSW10	EBC	300	0.3	40	30	0.75	30	3	45	10
MPSW42	EBC	300	0.3	40	30	0.5	20	2	50	10
BDC07	ECB	250	0.5	200	50	2	20	2 2	60	10
MPS6734	EBC	250	0.3	40	10	2 2	20	2	50	10
MPSW43	EBC	200	0.3	50	30	0.4	20	2	50	10
MPS6733	EBC	200	0.3	40	10	2	20	2	50	10

TABLE 5. High-Voltage Amplifier Transistors (continued) and being being

Device Type	Pin bu	V(BR)CEO Volts Min	I _C Max mA	h _{FE} @	I _C	V _F Volts Max	VCE(sat) @ IC mA	I _B	f _T MHz Min	@ Ic mA
Type	Out	IVIIII	MA	MIII	MA	IVIAX	IIIA	MA	MIII	mA
PNP — TO)-226AA									
BF493S	EBC	350	0.5	40	10	20	20	2	50	10
2N6520	EBC	350	0.5	30	30	3	10	1	40	10
BF493	EBC	350	0.5	40	10	0.2	20	2	50	10
MPSA92	EBC	300	0.5	40	10	0.5	20	2	50	10
2N6519	EBC	300	0.5	45	30	0.3	10	0.15	40	10
BF492	EBC	250	0.5	40	10	0.2	20	2	50	10
BF491	EBC	200	0.5	40	10	0.2	20	2	50	10
MPSA93	EBC	200	0.5	40	10	0.4	20	2	50	10
2N5401	EBC	150	0.6	60	10	0.2	10	1	100	10
2N5400	EBC	120	0.6	40	10	0.2	10	1	100	10
MPSL51	EBC	100	0.6	40	50	0.25	10	1	50	98 10 M
NP — TO)-226AE (1	WATT)							226AA	OT - 109
BDC06	ECB	300	0.5	40	25	2	20	2	60	A MI 10 HM
MPSW60	EBC	300	0.5	25	30	0.75	20	2	60	0 10 48
MPSW92	EBC	300	0.3	25	30	0.5	20	2	50	10
BDC08	ECB	250	0.5	40 081	25	2	20	2	60	10
MPSW93	EBC	200	0.3	25	30	0.5	20	2	50	UA 10
04	700	10 10	81.0	90	00	33.1	497	-08	(C)	DOWN TWI

TABLE 6. RF Transistors

The RF transistors are designed for Small Signal amplification from RF to VHF/UHF frequencies. They are also used as mixers and oscillators in the same frequency ranges. Several types are AGC characterized. The transistors are listed in order of decreasing f_T Min.

Device Type	Pin Out	V(BR)CEO Volts Min	I _C Max mA	hFE Min	Ic	VCE	f _T Typ MHz	CRE/CRB pF Max	NF Typ dB	f MHz
NPN — TO	D-226AA	Am	Am	xsM	Am	niid - xe	NA .	sith	100	Type
BF373	BEC	45	100	38	7	10	720	0.32	-22 55 A)T19
BF241	CEB	40	25	35	1	10	470	0.34	2.5	100
BF240	CEB	40	25	65	8 1	10	600	0.34	2.5	100
BF224	CEB	30	50	890 30	8 7	10	600	0.28#	2.5	100
MPSH32	BEC	30	30	27	4	5	300*	_	3.3*	45
MPSH24	BEC	30	100	30	8	10	400*	0.36	-AABSS-	21-2190
MPSH20	BEC	30	100	25	4	10	400*	ao	Des -	A 50 = 38
MPSH07	EBC	30	25	20	3	10	400*	0.3	_	_
MPS3866	EBC	30	400	\$0 10	50	5	500*	57	383	10 <u>20</u> Rh
BF371	BEC	30	100	38	7	10	720	0.23#	_	_
MPSH11	BEC	25	25	60	4	10	660*		_	_
MPSH10	BEC	25	100	60	4	10	1500	0.7	etor mal	o cu se lla
BF375	BEC	25	100	35	1	10	800	0.6	4	100
BF374	BEC	25	100	70	ofeorlage ni	10	800	0.6	DBQ8 416 85	100
BF199	CEB	25	100	40	7	10	750	0.35	2.5	35
MPSH30	BEC	20	50	20	4	5	300*		6*	100
BF959	CEB	20	100	40	20	10	800	0.65#	3	200
BF254	CEB	20	100	65	xe85.1 c	10 10	260	0.9#	1.7	71
MPSH17	BEC	15	100	25	5	10	1600	0.9	6*	200
MPS918	EBC	15	50	20	8	10	800	1.7	6*	60
MPS5179	EBC	12	50	25	3	1 ma	2000	-	4.5*	200
MPS3563	EBC	12 089	50	20	058 8 c	10	800	1.7	6*	60
MPSH04	EBC	10 -000	30	30	1.5	10	80*	003	2*	ARREST TRAIN
PNP — TO	D-226AA	7005	01	01	- ATT	87 008	- 64	088	WESSER	-52A A
MPSH55	BEC	80	100	30	0881.5	10 000	80	250	82/08	(42/0)
MPSH55	BEC	80	100	30	1.5	10 000	80	- 		22722 96
BF506	CBE	35 080	50	20	- 3	10 000	600	0.25	2234	200
2N5208	BEC	25	50	20	2	10	300*	_	3*	100
MPSH81	BEC	20	50	60	5	10	700	0.85	_	-

TABLE 1. HIGH-Speed Saturated Switching Transistors That Testinging agenty-right to Light

The transistors listed in this table are specially optimized for high-speed saturated switches. They are heavily gold doped and processed to provide very short switching times and low output capacitance (below 6 pF). The transistors are listed in order of decreasing turn-on time (t_{On}).

Device Type	ton ns Max	toff & ns @ Max	I _C	V(BR)CEO Volts Min	hFE @	I _C mA	VCEO(sat) Volts @ Max	I _C mA	& IB	f _T MHz Min	@ Ic mA
PN — TO-	226AA	2	20	9.0	01	0.0	0.5		Ges one	583	SELES MPSASS
2N3904	0.70	250	10	40	100	10	0.2	10	000 1	○8 300	10
2N3903	70	225	10	40	50	10	0.2	10	082 1	250	10
2N4400	35	255	150	40	50	150	0.4	150	15	200	20
2N4264	25	35	10	150	40	10	0.22	10	008 1	300	10
2N4265	25	35	10	120	100	10	0.22	10	001 1	300	10
MPS3646	18	28	300	150	30	30	0.2	30	3	350	30
MPS2369	0812	18	10	15	40	10 0	0.25	10	001 1	500	10
NP — TO-	226AA								(TTAW 1)	3-226AE)T - 98
MPS404A	223*	835*	10	251	30	12	0.2 8.0	24	008 1	803_	8020
2N3906	70	250	10	40	100	10	0.25	10	008 1	250	10
2N3905	0370	225	10	40	100	10	0.25	10	008 1	200	10
2N4402	35	255	150	40	50	150	0.4 8.0	150	15	150	20
MPS3640	25	35	50	120	30	10	0.2	10	002 1	500	10
MPS4258	15	20	10	12	30	50	0.15	10	1	700	10
2N5771	15	20	10	15	50	10	0.18	10	1	850	10

¹V(BR)EBO

TABLE 8. Choppers

Devices are listed in decreasing (V(BR)EBO)

Device Type	Pin Out	V(BR)EBO Volts Min	I _C Amp* Max	h _{FE} Min	@ IC mA	VCE(sat) Volts Max	Am IC mA	& IB mA	f _T (MHz Min	I _C mA
Device Pin Volts Amp* Min Max Min Min		BF373								
MPSA17	EBC	15	100	200	5	0.25	10	GS 1	100	5
MPSA16	EBC	98S.012 0	100	200	5	0.25	08 10	08 1		5
Device Pin Out Wils Amp* New New		MPSHI-								
MPS404A	EBC	25	150	30	12	0.2	24			MPSHEE
MPS404	EBC	12	150	30	92 12	0.2	24			8538 5 9M
		2000		27.5	700	1147	0.00	0.6	75.30	1500000

TABLE 9. Industrial Transistors

These devices are special products ranges intended for use in applications which require well specified high performing devices like high quality amplifier differential input, driver stage.

NPN	PNP	Pin Out	V _{(BR)CEO} (Volts)	I _C (mA) Cont	h Min	FE Max	@ Ic (mA)	V _{CE} (Volts)	f _T Typ (MHz)	Typ (dB)	t _{on} ns Typ	t _{off} ns
TO-226AA	-79	9.0	008	-01		8	25	03	61 61		586 586	NPS9 8
00%	MPS2907A	EBC	60	600	100	8	10	10	200*	1	45	100
BCX59	BCX79	CBE	45	200	120	630	2	5	250	2	75	600/350
MPS2222A	- 'S	EBC	40	600	75	23	10	10	300*	_	30	270
_	MPS2907	EBC	40	600	75	-	10	10	200*	_	45	100
MPS6531	MPS6534	EBC	40	600	90	270	100	1	250		30	250
BCX58	BCX78	CBE	32	200	120	630	2	5	250	2	75	600/35
MPS2222		EBC	30	600	75	8.1 -	10	10	250*		30	270
MPS6532	MPS6535	EBC	30	600	30	8 -	100	108	250	-	30	250
fr Min	18		300	UT.		2	-02	00	0.5		UEU	MACE

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

IADLE 10. TELECOM TRANSISTORS

These devices are special product ranges intended for use in Telecom application which require an excellent long term reliability.

		DI 10	P _D mW	XeV		- h	FE alloy	Pits	fT
Type	Pin Out	V(BR)CEO Volts	25°C Amb	I _C (mA) Cont	Min	Max	I _C (mA)	V _{CE} (V)	Min MHz
NPN — TO-226A	50	601	068	ns I a	T one	l las	teri	283	City Man
P2N2222	CBE	30	625	600	75 000	-68	10	8 10	250
P2N2222A	CBE	40	625	600	75 005	-63	10	010	300
(1)PBF259,S	EBC	300	625	500	25	08	108	10	40
(1)PBF259R,RS	CBE	300	625	68 500	25 000	DS	100	10	40
PNP — TO-226AA	7.0	001	400	1.5 40	200	56 56	03	283 E08	850 OSB
P2N2907	CBE	40	625	600	75 003	08	10	10	200
P2N2907A	CBE	60	625	600	100	-08	10	10	200
(2)PBF493,S	EBC	300	625	500	40	4025	100	10	40
(2)PBF493R,RS	CBE	300	625	500	40	68	10	10	40

^{(1) &}quot;S" version, hFE Min 60 $\it (a$ IC = 20 mA, VCE = 10 V. (2) "S" version, hFE Min 40 $\it (a$ IC = 0.1 mA, VCE = 1 V.

TABLE 11. Central Collector 800 mW

The transistors listed in this table have been designed to provide power dissipation. These devices are listed in order of decreasing breakdown voltage ($V_{(BR)CEO}$).

Device Type	Pin Out	V(BR)CEO Volts Min	Amp Cont	hFE (@ IC mA	VCE(sat) Volts Max	a I _C (a I _B	f _T MHz Min	a IC
NPN — TO-22	26AA	0 = 890		SkyV			RI I		(88) ^V	
BF420	ECB	300	0.1	40	25	2	20	2	60	10
BF422	ECB	250	0.1	50	25	2	20	2	60	10
BC639	ECB	80	1	40	150	0.5	500	50	60	10
BC637	ECB	60	1	40	150	0.5	500	50	60	10
BC635	ECB	45	1	40	150	0.5	500	50	60	10
BC368	ECB	20	1	60	1000	0.5	1000	100	65	10
PNP — TO-22	6AA									
BF421	ECB	300	0.1	40	25	2	20	2	60	10
BF423	ECB	250	0.1	50	25	2	20	2	60	10
BC640	ECB	80	1	40	150	0.5	500	50	60	10
BC639	ECB	60	1	40	150	0.5	500	50	60	10
BC636	ECB	45	1	40	150	0.5	500	50	60	10
BC369	ECB	20	1	60	1000	0.5	1000	100	65	10

TABLE 12. TO-226AE — 1 Watt High-Current

	0	V(BR)CEO	MHz	5.0	Ic	hF	E @	88	VCE	(sat)	GAST VA
Device	Pin Out	Volts Min	f _T Min	I _C	Max A	Min	Max	IC mA	Max V	I _C mA	I _B mA
NPN											
BDB01D	EBC	100	50	200	1.5	40	400	100	0.7	1000	100
BDC01D	ECB	100	50	200	1.5	40	400	100	0.7	1000	100
BDB01C	EBC	80	50	200	1.5	40	400	100	0.7	1000	100
BDC01C	ECB	80	50	200	1.5	40	400	100	0.7	1000	100
MPS6717	EBC	80	50	200	0.5	80	_	50	0.5	250	10
MPSW06	EBC	80	50	200	0.5	50	-	50	0.4	250	10
BDB01B	EBC	60	50	200	1.5	40	400	100	0.7	1000	100
BDC01B	ECB	60	50	200	1.5	40	400	100	0.7	1000	100
MPSW05	EBC	60	50	200	0.5	80	_	50	0.4	250	10
MPS6716	EBC	60	50	200	0.5	80	_	50	0.5	250	10
BDB01A	EBC	45	50	200	1.5	40	400	100	0.7	1000	100
BDC01A	ECB	45	50	200	1.5	40	400	100	0.7	1000	100
MPS6715	EBC	40	50	50	1	50	_	1000	0.5	1000	100
MPSW01A	EBC	40	50	50	1	50	_	1000	0.5	1000	100
MPS6714	EBC	30	50	50	1	50	_	1000	0.5	1000	100
MPSW01	EBC	30	50	50	1	50	_	1000	0.5	1000	100

BIPOLAR DEVICES — PLASTIC-ENCAPSULATED (continued) TRALIG RALIOSIS

TABLE 12. TO-226AE — 1 Watt High-Current (continued)

		V(BR)CEO	MHz		IC	h	FE @		VCE	(sat)	
Device	Pin Out	Volts Min	f _T Min	mA	Max	Min	Max	I _C	Max V	I _C mA	IB mA
NP	(1) 301	(Wash) Ch	7439	1986		Blow	EMBIN	SHOW	338.3		MG T
BDB02D	EBC	100	50	200	1.5	40	400	100	0.7	1000	100
BDC02D	ECB	100	50	200	1.5	608 40	400	100	0.7	1000	100
BDB02C	EBC	80	50	200	1.5	40	400	100	0.7	1000	100
BDC02C	ECB	80	50 —	200	1.5	40	400	100	0.7	1000	100
MPS6729	EBC	80	50	200	0.5	80	826	50	0.5	250	10
BDB02B	EBC	60	50	200	1.5	40	400	100	0.7	1000	100
BDC02B	ECB	60	50	200	1.5	40	400	100	0.7	1000	100
MPS6728	EBC	60	50	200	0.5	80	898-	50	0.5	250	10
MPSW55	EBC	60	50	200	0.5	80	828-	50	0.4	250	10
BDB02A	EBC	45	50	200	1.5	40	400	100	0.7	1000	100
BDC02A	ECB	45	50	200	1.5	40	400	100	0.7	1000	100
MPS6727	EBC	40	50	50	1	50		1000	0.5	1000	100
MPSW51A	EBC	40	50	50	1	50	- V	1000	0.5	1000	100
MPS6726	EBC	30	50	50	1	50	_	1000	0.5	1000	100
MPSW51	EBC	30	50	50	1	50	Witness Clif	1000	0.5	1000	100

TABLE 13. Dual Diodes

Dual diodes designed for use in low cost biasing, steering and voltage doubler applications including series, common cathode and common anode diodes.

Device Type	V(BR) Volts	l(BR)	I _R μA Max	v _R Volts	V _F @ Volts Min/Max	IF mA	C _{VR} = 0 pF Max	t _{rr} ns Max	Description
TO-226AC	08	50	00 8 00 8	0 081	40	110	033	808	20139 20139
MSD6100 MSD6102	100 70	100 100	0.1 0.1	50 50	0.67/0.82 0.76/1	10 10	1.5	4 100	Switching Common Cathode

TABLE 14. Voltage Reference Diode

These devices are highly reliable temperature compensated monolithic integrated circuit voltage stabilizer designed for use in television and FM radios that use variable capacitance diode tuners.

- 07	08	08	909	v	Z (V)	04	1		Δ V ₇ /ΔT (1	mV/°C)	C833
Devic		P _D (mW)	Min	0.0	Max	I _{ZT} (mA)	Туре	@	IZT (mA)	T/Min (°C)	T/Max (°C)
TO-226AC	0					men	uu-ngan	335 99	1 BA	025-01	PI DIEM
MVS240	(na	625	23	@	25	5	-0.2	sh58	5)30(Air)V		70
						A		177 11884	nilit	180	Sevice



Motorola small-signal metal can transistors are designed for use as general-purpose amplifiers, high-speed switches, high-voltage amplifiers, low-level/low-noise amplifiers, high-frequency oscillators, choppers, and Darlingtons. These devices are manufactured in a variety of packages, i.e., TO-18, TO-205AD, TO-46, TO-52, and TO-72.

A separate listing on page 1-42 indicates those Motorola small-signal metal can transistors which are qualified to MIL-19500 high-rel requirements. Devices are available in the JAN, JANTXV, JANS and CECC qualified versions as specified.



TABLE 15. General-Purpose Amplifiers

These transistors are designed for dc to VHF amplifier applications, general-purpose switching applications, and complementary circuitry. Devices are listed in decreasing order of $V_{(BR)CEO}$ within each package group.

001 001	Device	V(BR)CEO Volts	oa fT oa MHz	06 @ 08 Ic	OGO IC	40	8C140-10 hpE 47-04-108	@ lc
Package	Type	OA Min	Min Min	mA	Max	Min	n _{FE} Max	@ IC
NPN	250	001	20	08	0001	40	62X45-16	
TO-18	2N2896	90	1000	120	000 50	60	200	150
	2N3700#	08 80	1000	80	00011.0	50	08 <u>Y 181</u>	500
	2N2895	65	1000	120	50	40	120	150
	2N2484#	60	50	085 15	0.05	100	500	0.01
	2N956	50	68	70	008 50	40	120	150
	2N2897	45	1000	08 100	0001 50	50	200	150
	2N930	45	08 30	08 30	0001 0.5	100	300	0.01
	BC107	45	200	150	008 10	0 110	450	2.0
	BC107A	45	200	150	008 10	0% 110	220	2.0
	BC107B	45	200	150	10	200	450	2.0
	BC107C	45	200	150	10	420	800	2.0
	BCY59	45	200	125	10	120	630	2.0
	BCY59-IX	45	200	125	10	250	460	2.0
	BCY59-VII	45	200	125	10	120	220	2.0
	BCY59-VIII	45	200	125	10	180	310	2.0
	BCY59-X	45	200	125	10	380	630	2.0
	2N2218#	40	800	250	20	40	120	150
	2N2221A#	40	800	250	20	40	120	150
	2N2222A#	40	800	300	20	100	300	150
	2N3946	4()	200	300	10	50	150	10
	2N3947	40	200	300	10	100	300	10
	2N718	40	91	50	50	40	120	150
	BCY58	32	200	125	10	120	630	2.0
	BCY58-IX	32	200	125	10	250	460	2.0
	BCY58-VII	32	200	125	10	120	220	2.0
	BCY58-VIII	32	200	125	10	180	310	2.0
	BCY58-X	32	200	125	10	380	630	2.0
	2N2222#	30	800	250	20	100	300	150
	2N3302	30	500	250	50	100	300	150
	2N916*	25	000	300	10	50	200	10
	BC108	25	100	150	10	110	800	2.0
	BC108A	25	100	150	10	110	220	2.0
	BC108B	25	100	150	10	200	450	2.0
	BC108C	25	100	150	10	420	800	2.0
	BC109	25	100	150	10	200	800	2.0
	BC109A	25	100	150	10	110	220	2.0
	BC109B	25	100	150	10	200	450	2.0
	BC109C	25	100	150	10	420	800	2.0
	BSX51	25	200	150	10	75	225	2.0

#JAN/JANTX/JANTXV available

Pooks	Device	V(BR)CEO Volts Min	fT MHz Min	lc mA	Max	Min	hFE Max	@ I _C
Package	Туре	MIN	MILL	mA	Max	MIII	Max	mA
PN (continu	ied)							
TO-205AD	2N1711	80	(6)	70	50	100	300	150
	2N3019#	80	1000	100	50	100	300	150
	2N3020	80	1000	80	50	40	120	150
	BSX47-10	80	1000	50	20	63	160	100
		80		50	20	100	250 VO	100
	BSX47-16	A STATE OF THE PARTY OF THE PAR	1000			40		100
	BSX47-6	80	1000	50 80 80	20/19/19		100	
	BC141	60	1000	50	50 07 1		400	100
	BC141-10	60	1000	50 000	old 50 1 es	63	160	100
	BC141-16	60	1000	50	50	100	250	100
	BC141-6	60	1000	50	50	40	100	100
	BSX46-10	60	1000	50	20	63	160	100
	BSX46-16	60	1000	50	20	100	250	100
	BSX46-6	60	1000	50	20	40	100	100
	2N1613#	50	500	60	50	40	120	150
	2N2270	45	1000	100	50	50	200	150
	2N2219A#	40	800	300	20	100	300	150
	2N3053	40	700	100	50	50	250	150
	2N697	40	200	THOMESON OF THE		40	120	150
	BC140	40		50	50	40		100
	BC140 BC140-10	40	1000		FO	63	400 160	100
			1000	50	50	400		
	BC140-16	40	1000	50	EMM 50	100	250	100
	BC140-6	40	28341000	50 h	50	40	100	100
	BSX45-10	40	1000	50	20	63	160	100
	BSX45-16	40	1000	50	20	100	250	100
	BSX45-6	40	1000	50	0001 20	40	100	100
	BFY50	35	1000	60	50	08 30	*00T 01 IS	150
	2N2218#	30	800	250	20	40	120	150
	2N2219#	30	800	250	20	100	300	150
	2N3300	30	500	250	50	100	300	150
	BFY51	20	1000	50	000 50	40	2 45 807	150
	BFY52	20	1000	50	50	50	1003113	150
PD A	13180	3,020	0.0	- 100	- 5/0		TANGE	-
TO-46	2N5581**	40	800	250	20	40	120	150
0.8	2N5582**	40	800	300	20	100	300	150
TO-52	MM3903	40	200	250	10	50	150	10
	MM3904	40	200	300	10	100	300	10
NP	460	250	01	125	200	45	BCYsBitx	
TO-18	2N3963	80	200	40	0.5	100	450	1.0
0.5	2N4026	80	1000	100	50	15	HIV-SCT-DG	100
	2N4026 2N4027	80	1000	100	50	10	X-65103	100
	2N4027 2N4028	80	1000	150	008 50	40	2N2218#	
	73300	400	1900 1000		130.30	200	2N2221A#	100
	2N4029	80	1000	150	50	25	21/2222A#	100
	2N2906A#	60	600	200	50	40	120	150
	2N2907A	60	600	200	50	100	300	150
	2N3250A#	60	200	250	10	50	150	10
	2N3251A#	60	200	300	10	100	300	10
	2N3799	60	50	30	0.5	300	900	0.5
	2N3964			50	0.5	250	600	1.0
	BC177	45	200	200	10	120	460	2.0
	BC177A	45	200	200	10	120	220	2.0
	BC177B	45	200	200	10	190	460	2.0
	BC177C	45	200	200	10	380	800	2.0
	BC177VI	45	200	200	10	70	140	2.0
	BCY71	45	200	10	200	100	600	10
	BCY79-IX	45	200	180	10	250	460	2.0
	BCY79-VII	45	200	180	10	120	220	2.0
		45			23637		2024775.7256	
	BCY79-VIII	45	200	180	10	180	310	2.0
	BCY79-X	45	200	180	10	380	630	2.0
	2N2906#	40	600	200	50	40	120	150
	2N2907#	40	600	200	50	100	300	150
	2N3250	40	200	250		50	150	10
	2N3251	40	200	300	10	100	300	10

**JAN/JANTX available #JAN/JANTX/JANTXV available

		V(BR)CEO	fT		IC			
Package	Device	Volts Min	MHz Min	@ Ic	mA Max	Min	hFE Max	@ IC mA
	Type			91	Iviax	100 LCC 100 E17 100	WidX	mA
NP (continu	ued)	3) B	ga January	Am	SHOV nisk	Typ' Max	SPEVICE	portation and
TO-18	BCY78-IX	32	200	180	10	250	460	2.0
	BCY78-VII	32	200	180	10	120	220	2.0
	BCY78-VIII	32	200	180	10	180	310	2.0
	BCY78-X	32	200	180	10	380	630	2.0
	BC178	25	200	200	10	120	800	2.0
	BC178A	25	200	200	10	120	220	2.0
	BC178B	25	200	200	10			
						180	460	2.0
	BC178C	25	200	200	08 10	380	800	2.0
	BC178VI	25	200	200	10	70	140	2.0
	BCY72	25	200	250	(a 10	50	- 1 3986/45	10
	BC179	20	200	200	10	180	800	2.0
	BC179-VI	20	200	200	10	70	140	2.0
	BC179A	20	200	200	10	120	220	2.0
	BC179B	20	200	200	10	180	460	2.0
	BC179C							
		20	200	200	10	380	800	2.0
	2N869A	18	120	400	10	40	120	30
TO-205AD	MM5007	100	2000	30	50	50	250	250
	2N4031	80	1000	100	50	10		100
	2N4031#	80	1000	150	50	25	stloV-apiH	100
	Georgia e e e e							
	2N4404	80	1000	200	50	40	120	150
	2N4405**	80	1000	200	50	100	300	150
	BSV17-10	80	1000	50	50	63	160	100
	BSV17-6	80	1000	50	50	40	100	100
	MM5006	80	2000	30	50	50	250	200
	BFX40	75	1000	100	50	85	200	100
	BFX41	75	1000	100	50	40	6641	
								100
	2N4036	65	1000	60	50	40	140	150
	2N4037	65	1000	60	50	40	2NG4 3T	150
	MM4036	65	1000	60	50	20	140	150
	2N2904A#	60	600	200	50	40	120	150
	2N2905A	60	600	200	50	100	300	150
	2N4030	60	1000	100	50	15		100
	2N4032	60	1000		50	40000	47000	100
	BC161	60					100	
	The second secon		1000	50	50	40	400	100
	BC161-10	60	1000	50	50	63	160	100
	BC161-16	60	1000	50	50	100	250	100
	BC161-6	60	1000	50	50	40	100	100
	BSV16-10	60	1000	50	50	63	160	100
	BSV16-16	60	1000	50	50	100	250	100
	BSV16-6	60	1000	50	50	40	100	100
	MM5005	60	2000	30	50	DI TRADE		
			10.0			50	250	150
	2N1131A	40	600	50	50	30	90	150
	2N1132A	40	600	60	50	30	90	150
	2N2904#	40	600	200	50	40	120	150
	2N2905#	40	600	200	50	100	300	150
	BC160	40	1000	50	50	40	400	100
	BC160-10	40	1000	50	50	63	160	100
	BC160-16	40	1000	50	50	100	250	100
	BC160-16	40	1000	50	50	40		0.000
				50	0.000	1120.0	100	100
	BSV15-10	40	1000	50	50	63	160	100
	BSV15-16	40	1000	50	50	100	250	100
	BSV15-6	40	1000	50	50	40	100	100
	MM4037	40	1000	60	50	50	250	150
	2N1132	35	600	60	50	30	90	150
TO 10	10 10 10	0.00		- GA	0301	02.5	10000 IAC	
TO-46	2N3485A**	60	600	200	50	40	120	150
	2N3486A**	60	600	200	50	100	300	150
	2N3673	50	600	200	50	75	225	150
	2N3486	40	600	200	50	100	300	150
TO 50							-	
TO-52	MM3906	40	200	250	10	100	300	10
	MM3905	40	200	200	10	50	150	10

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

TABLE 16. High-Gain/Low-Noise Transistors unifnoo) availing A ecoquid-terent 21 3JBAT

These transistors are characterized for high-gain and low-noise applications. Devices are listed in decreasing order of NF.

	x8M 346	NF Wideband	V _(BR) CEO	Am Ic	ni38		IC	f _T	
Package	Device Type	Typ* Max dB	Volts Min	mA Max	h _F Min	E @ @	μA mA*	MHz Min	@ IC M
NPN	020	200	gr gr	081	200	38	RI-E	SCY2	61-01
TO-18	2N2484#	8.0*	60	50	100	500	10	15	0.05
	2N930A	3.0	45	30	100	300	10	45	0.5
	2N930**	3.0	45	009 30	100	300	10	30	0.5
PNP	220	021	01	200	000	85		NIOB -	
TO-18	2N3962	10	60	200	100	450	1.0	40	0.5
	2N3963	10	80	200	100	450	1.0 N	40	0.5
	2N3965	8.0	60	200	250	600	1.0	50	0.5
	2N3964	4.0	45	200	250	600	1.0	50	0.5
	2N3798	3.5	60	50	150	450	500	30	0.5
	2N3799	2.5	60	50	300	900	500	30	0.5
TO-46	2N2604	4.0	45	30	40	120	0.01	30	0.5
	2N2605#	4.0	45	30	100	300	0.01	30	0.5

TABLE 17. High-Voltage/High-Current Amplifiers

The following table lists Motorola standard devices that have high Collector-Emitter Breakdown Voltage. Devices are listed in decreasing order of $V_{(BR)CEO}$ within each package type.

	Device	V(BR)CEO Volts	I _C	hee a a		VCE(sat) Volts	ı Ic &	I _B 800	f _T MHz	(a c
Package	Туре	Min	Max	Min	mA	Max	mA	mA	Min	@ IC
NPN										
TO-18	2N6431	300	50	50	30	0.5	20	2.0	50	10
	BSS73	300	500	40	30	0.5	50	5.0	100	20
	BSS72	250	500	40	30	0.5	50	5.0	100	20
	2N6430	200	50	50	30	0.5	20	2.0	50	10
	BSS71	200	500	40	30	0.5	50	5.0	100	20
	BC394	180	500	30	10	0.3	10	1.0	50	20
TO-205AD	2N3439#	350	1000	40	20	0.5	50	4.0	15	10
	2N5058	300	150	35	30	1.0	30	3.0	30	10
	BF259	300	100	25	30	1.0	30	6.0	110	30
	2N3440#	250	1000	40	20	0.5	50	4.0	15	10
	2N4927	250	50	20	30	2.0	30	3.0	30	10
	2N5059	250	150	30	30	1.0	30	3.0	30	10
	MM3002	250	50	20	10	UVUT -	NO.	2000	150	10
	BF258	250	100	25	30	1.0	30	6.0	110	30
	BSS78	250	500	40	30	0.4	30	3.0	70	20
	2N4926	200	50	20	30	2.0	30	3.0	30	10
	BUY49S	200	3000	40	500	0.2	500	50	12kt2	_
	MM3002	200	50	20	10	100	000	- 100	150	10
	BSS77	200	500	40	30	0.4	30	3.0	70	20
	MM3009	180	400	40	10	0001	08	-01-0	50	20
	BF357	160	100	25	30	1.0	30	6.0	110	30
	2N3500#	150	300	40	150	0.4	150	15	150	20
	2N3501#	150	300	100	150	0.4	150	15	150	20
	3N3114	150	200	30	30	1.0	50	5.0	40	30
	BSW68A	150	2000	30	500	1.0	500	150	1000	_
	MM3009	150	200	20	10	1007	1,200	- 194	150	10
	2N5682	120	1000	40	250	0.6	250	25	30	100
	BSW67A	120	2000	30	500	1.0	500	150	EVIS_	84-DI
	2N3498#	100	500	40	150	0.6	300	30	150	20
	2N3499#	100	500	100	150	0.6	300	30		20
	2N5681	100	1000	40	250	0.6	250	25	30	100
	2N657	100	-	300	200	4.0	200	40	EMM -	DR 0#
	MM3007	100	2500	50	250	0.35	150	15	50	50
	2N4239	80	3000	30	250	0.3	500	50	2.0	100
	MM3006	80	2500	50	200	0.35	150	15	50	50

#JAN/JANTX/JANTXV available

TABLE 17. High-Voltage High-Current Amplifiers (continued)

		Device	Wei	V(BR)CEO Volts Min	IC mA Max	hFE @	I _C	VCE(sat) Volts Max		& IB		a I _C
	kage	Туре			Wax	. IVIII			no!	no!	IVIIII	IIIA
NPN	(contin	nued)		(RE)ERV			030048	17	100	48	palmed	,
TO-2	05AD	3N4238	Am	60	3000	30	250	0.3	500	50	2.0	100
		MM3005	177	60	2500	50	150	0.35	150	15	50	50
		2N4237		40	3000	30	250	0.3	500	50	2.0	100
PNP												
TC	-18	2N6433	502	300	500	30	30	0.5	20	20	50	10
		BSS76		300	500	35	30	0.5	50	5.0	100	20
		BSS75		250	500	35	30	0.5	50	5.0	100	20
		2N6432		200	1000	30	30	0.5	20	2.0	50	10
		BSS74		200	500	35	30	0.5	50	5.0	100	20
		BC393		180	500	50	10	0.3	10	1.0	50	20
		2N3497		120	100	40	10	0.35	10	1.0	150	20
		2N3496		80	100	40	10	0.3	10	1.0	200	20
TO-2	05AD	2N3494	17171	80	100	40	10	0.3	10	1.0	200	20
		2N3495		120	100	40	10	0.35	10	1.0	150	20
		2N3635#		140	1000	100	50	0.5	50	5.0	200	30
		2N3636#		175	1000	50	50	0.5	50	5.0	150	30
		2N3637#		175	1000	100	50	0.5	50	5.0	200	30
		2N3743#		300	50	25	30	8.0	30	3.0	30	10
		2N4036		65	1000	40	150	0.65	150	15	60	50
		2N4234		40	3000	30	250	0.6	1000	125	3.0	100
		2N4235		60	3000	30	250	0.6	1000	125	3.0	100
		2N4236		80	3000	30	250	0.6	1000	125	3.0	100
		2N4928		100	100	25	10	0.5	10	1.0	100	20
		2N4929		150	500	25	10	0.5	10	1.0	100	20
		2N4930#		200	500	20	20	5.0	10	1.0	20	20
		2N4931#		250	500	20	20	5.0	10	1.0	20	20
		2N5415#		200	1000	30	50	2.5	50	5.0	15	10
		2N5416#		300	1000	30	50	2.5	50	5.0	15	10
		2N5679		100	1000	40	250	0.6	250	25	30	100
		2N5680		120	1000	40	250	0.6	250	25	30	100
		3N3634#		140	1000	50	50	0.5	50	5.0	150	30
		MM4000		100	100	20	20	0.6	10	1.0	_	
		MM4001		150	500	20	10	0.6	10	1.0		_
		MM4002		200	500	20	10	5.0	10	1.0	SERVICE	80.73
		MM4003		250	500	20	10	5.0	10	1.0	**A.D. 20150	
		MM5005		60	2000	50	150	0.5	150	1.0	30	50
		MM5006		80	2000	50	200	0.5	150	15	30	50
		MM5007		100	2000	50	250	0.5	150	15	30	50
177	790	NTXV available	10	8.0	2000	00 A (00 C	200	0.0	130	81	615 PM	30

TABLE 18. High-Frequency Amplifiers/Oscillators

The transistors shown are designed for use as both oscillators and amplifiers at UHF and VHF frequencies. Devices are listed in decreasing order of V(BR)CEO with each line.

	0,0,1,00	0.0								
Package	Device Type	V(BR)CEO Volts Min	h _{FE} Min	@ I _C	G _{pe} dB Min	NF dB @ Max	f MHz	f _T MHz Min	@ I _C	C _{obo} pF Max
NPN	00 50		968	08 000h	92	500	aar	aa .	343845	
TO-18	MM1941	20	25	10	7.0	3000	- OBI	600	10	2.5
TO-72	2N918†	150	20	3.0	15	6.0	60	600	4.0	1.7
PNP			0001	1500 30	0.0	1080	115	E&.	#18/18/45 #18/18/45	
TO-18	2N3307	35	40	2.0	1708	4.5	200	300	2.0	1.3
TO-72	2N4261# 2N4260	15 15	30 30	10 10	-08	50 <u>0</u>	00	1600 2000	10 10	2.5 2.5

*JAN available *JAN/JANTX available †JAN/JANTX/JANTXV/JANS available #JAN/JANTX/JANTXV available

The ionowing devices are intended for use in general-purpose switching and amplifier applications. Within each package group shown, the devices are listed in order of decreasing turn-on time (t_{0n}) .

	Device	ton ns	toff & ns	a lc	V(BR)CEO Volts	I _C	hFE	@ lc	VCE(sat) Volts	@ lc @	e IB	MHz	Ic
Package	Туре	Max	Max	mA	Min	Max	Min	mA	Max	mA	mA	Min	mA
NPN	0.5	65	006	0.3	089	-00		3000	10		VESAV	S	
TO-18	2N2540	40	40	150	30	_	100	150	0.45	150	15	250	20
	2N914**	40	40	200	15	150	12	10	0.7	200	20	300	20
01	2N4014	35	60	500	50	1000	35	500	0.52	500	50	300	50
OS	2N4013	35	60	500	30	1000	35	500	0.42	500	50	300	50
08	2N2501	15	25	300	20	- 88	10	500	0.3	50	5.0	350	10
0.0	2N2369	12	18	100	15	500	20	100	0.25	10	1.0	500	10
20	2N2369A†	12	18	10	15	200	40	10	0.2	10	1.0	500	10
09.	2N3227	12	18	100	20	50	30	100	0.25	10	1.0	500	10
02	BSX20	7.0	18	100	15	500	20	10	0.25	10	1.0	400	10
TO-205AD	2N3444**	50	70	500	50	-	20	500	0.6	500	50	175	50
115.	2N3253**	50	70	500	40	- 00	25	500	0.6	500	50	175	50
2.0	2N3735#	48	60	1000	50	1500	20	1000	0.5	500	50	250	50
30	2N3734	48	60	1000	50	1500	30	1000	0.5	500	50	250	50
0.6	2N3252	45	70	500	30	- 08	30	500	0.5	500	50	200	50
30	2N3506#	45	90	1500	40	3000	40	1500	1.0	1500	150	60	100
0.0	2N3507#	45	90	1500	50	3000	30	1500	1.0	1500	150	60	100
08	BSX60	40	70	500	30	1000	30	500	0.5	500	50	_	-
100	2N3725	35	60	500	50	2000	35	500	0.52	500	50	300	50
807	2N3725A	35	60	500	30	1200	35	500	0.52	500	50	300	50
90,5	2N3724	35	60	500	30	2000	35	500	0.42	500	50	300	50
08	2N3724A	35	60	500	30	1200	35	500	0.42	500	50	300	50
0.8	BSX59	35	60	500	45	1000	25	500	0.5	500	50	15 —	_
0.5	MM5262	30	60	1000	50	2000	25	1000	0.8	1000	100	350(typ)	50
20.	2N5861	25	60	500	50	2000	25	500	0.5	500	50	200	50
97	2N3303	15	25	1000	-00	1000	20	10	0.7	1000	100	450	100
TO-46	2N3737#	48	60	1000	50	1500	20	1000	0.5	500	50	250	50
604	2N3648	16	18	150	15	500	30	150	0.4	150	15	450	15
TO-52	MM1748A	10	15	10	-08	150	20	10	<u> </u>	-	# 6008	600	5.0
PNP		0.1	01	8.0	95	05		500	180		10050	107	
TO-18	2N2894	60	90	30	12	200	40	30	0.2	30	3.0	400	30
	2N869A**	50	80	30	18	200	40	30	0.2	30	3.0	400	10
56	2N3546	40	30	50	12	_ 0	25	50	0.25	50	5.0	700	10
08	2N4208	15	20	10	12	200	30	10	0.15	10	1.0	700	10
50	MM4258	115	20	10	12	200	30	10	0.15	10	1.0	700	10
	2N4209	15	20	10	15	200	50	10	0.6	50	5.0	850	10
TO-205AD	2N3634#	400	600	50	140	1000	50	50	0.5	50	5.0	150	30
	2N3635#	400	600	50	140	1000	100	50	0.5	50	5.0	200	30
	2N3636#	400	600	50	175	1000	50	50	0.5	50	5.0	150	30
ni belai or	2N4036	110	700	150	65	1000	40	150	0.65	150	15	60	50
THE DESIGNATION OF R	2N4030	100	240(typ)	500	60	1000	15	1000	1.0	1000	100	100	50
· ·	2N4031	100	240(typ)	500	80	1000	10	1000	0.5	500	50	100	50
	2N4032	100	240(typ)	500	60	1000	40	1000	1.0	1000	100	150	50
oda-2	2N4033#	100	240(typ)	500	80	1000	25	1000	0.5	500	50	150	50
vetil.	2N4406	75	225	1000	80	1500	20	1000	0.7	1000	100	150	50
No.	2N4407	75	225	1000	80	1500	30	1000	0.7	1000	100	150	50
	2N3245	55	165	500	50	1000	30	500	0.6	500	50	150	50
20	2N3244	50	185	500	40	1000	50	500	0.5	500	50	175	50
0.3	2N3467#	40	90	500	40	100	40	500	0.5	500	50	175	50
1.7	2N3468#	40	90	500	50	1000	25	500	0.6	500	50	150	50
	2N3762#	43	115	1000	40	1500	30	1000	0.9	1000	100	180	50
	2N3763#	43	115	1000	60	1500	20	1000	0.9	1000	100	150	50
E 1	2N4404	40	210	500	80	1000	30	500	0.5	500	50	200	50
2.5	2N4405**	40	210	500	80	1000	50	500	0.5	500	50	200	50
8.5	2N5022	40	90	500		500	25	1000	0.8	1000	100	170	50
harry in the same	2N5023	40	90	500	_	500	40	1000	0.7	1000	100	200	50

[&]quot;JAN/JANTX available #JAN/JANTX/JANTXV available

Devices are listed in decreasing V(BR)EBO.

Package	Device	V(BR)EBO Min	V _{(BR)ECO}	hFE(inv) Min	Offset Voltage VEC(ofs) Max (mV)	On-State Resistance rec(on) Max (Ω)
PNP						
TO-46	2N2946A	40	35	20	2.0	8.0
	2N5230	30	20	ism to 159 .58u	0.5	8.0
	2N2945A	25	2001 Acids	30	1.10W (60:176 cost of	6.0
	2N2945	25	20	4.0	1.0 110121	35 - 40

JAN/JANTX available

all.

P-CHANNEL GO NI-CHANNE

TABLE 1. Low-Proguency nu-Moles

P-Charmel JFETS

		20			
	8.1				

WYTEN LANGUE TAM

	Nax					
0.1						
0.1						

Field-Effect Transistors

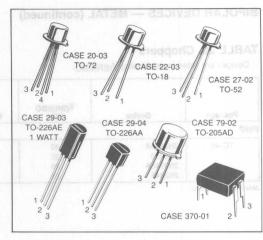
Motorola offers a line of field-effect transistors that encompasses the latest technology and covers the full range of FET applications. Included here is a wide variety of junction FETs (JFETs), MOSFETs (with P- or N-channel polarity with both single and dual gates) and TMOS FETs. These FETs include devices developed for operation across the frequency range from dc to UHF in switching and amplifying applications. Package options from low cost plastic to metal TO-72 packages are available. The selector guides on the following pages are designed to emphasize those FET families and device types that, by virtue of widespread industry use, ease of manufacture and, consequently, low relative cost, merit first consideration for new equipment design.

JFETs

JFETs operate in the depletion mode. They are available in both P- and N-channel are are offered in both metal and plastic packages. Applications include general-purpose amplifiers, switches and choppers, and RF amplifiers and mixers. These devices are economical and very rugged. The drain and source are interchangeable on many typical FETs.

TABLE 1. Low-Frequency/Low-Noise

P-Channel JFETs





		Re Yfs	Re Yos	C _{iss}	C _{rss}	V(BR)GSS V(BR)GDO	VGS	o(off)	ID	SS
Package TO-	Device	(mmho) Min	(μmho) Max	(pF) Max	(pF) Max	(V) Min	(\) Min	/) Max	(m Min	Max
72	2N3909	1.0	100	32	16	20	0.3	7.9	0.3	15
92	MPF2608	1.0	_	17	_	30	1.0	4.0	0.9	4.5
92	2N5460	1.0	50	7.0	2.0	40	0.75	6.0	1.0	5.0
92	2N5463	1.0	75	7.0	2.0	60	0.5	4.0	1.0	5.0
72	2N3330	1.5	40	20		20	_	6.0	2.0	6.0
92	MPF3330	1.5	40	20	-	20	_	6.0	2.0	6.0
92	2N5461	1.5	50	7.0	2.0	40	1.0	7.5	2.0	9.0
92	2N5464	1.5	75	7.0	2.0	60	0.8	4.5	2.0	9.0
92	2N5462	2.0	50	7.0	2.0	40	1.8	9.0	4.0	16
92	2N5465	2.0	75	7.0	2.0	60	1.5	6.0	4.0	16
72	2N3909A	2.2	100	9.0	3.0	20	0.3	7.9	1.0	15

N-Channel JFETs

		Re	Yfs	Re	Yos	C _{iss}	C _{rss}	V(BR)GSS V(BR)GDO	VGS	S(off)	ID	SS
Package TO-	Device	(mmho) Min	f (MHz)	(μmho) Max	f (MHz)	(pF) Max	(pF) Max	(V) Min	Min (V) Max	(m Min	Max
18	2N3370	0.3	30	15	30	20	3.0	40		3.2	0.1	0.6
92	J201	0.5	20	1.0 ^t	20	5.0 ^t	2.0t	40	0.3	1.5	0.2	1.0
18	2N3369	0.6	30	30	30	20	3.0	40		6.5	0.5	2.5
18	2N4339	0.8	15	15	15	7.0	3.0	50	0.6	1.8	0.5	1.5
92	MPF4339	0.8	15	15	15	7.0	3.0	50	0.6	1.8	0.5	1.5
18	2N3460	0.8	20	5.0	30	18	6.0	50	_	1.8	0.2	1.0
18	2N3438	0.8	20	5.0	30	18	6.0	50		2.3	0.2	1.0
72	2N4220	1.0	15	10	15	6.0	2.0	30	_	4.0	0.5	3.0
72	2N4220A	1.0	15	10	15	6.0	2.0	30	_	4.0	0.5	3.0

TABLE 1. Low-Frequency/Low-Noise (continued) and light a support of the continued of the co

N-Channel JFETs (continued)

	Vestorn	R _e	Yfs	Re	Yos	Ciss	C _{rss}	V(BR)GSS V(BR)GDO	VGS	G(off)	ID	SS
Package TO-	Device (%)	(mmho) Min	(MHz)	(μmho) Max	@ f (MHz)	(pF) Max	(pF) Max	(V) Min		V) Max	(m	Max
92	J202	1.0 00	20	3.5t	20	5.0 ^t	2.0t	40	0.8	4.0	0.9	4.5
18	2N3368	1.0	30	80	30	20	3.0	40	igs -	11.5	2.0	12
72	2N5359	1.2	15	10	0.115	6.0	2.0	40	0.08	8 4.0	0.6	1.6
18	2N4340	1.3	15	30	10.415	7.0	3.0	50	1.0	3.0	1.2	3.6
72	2N5360	1.4 08	15	20	2 15	6.0	2.0	40	0.8	8 4.0	0.5	2.5
92	2N5458	1.5	15	50	0.515	7.0 0.8	3.0	25	0.1.0	7.0	2.0	9.0
72	2N5361	1.5	15	20	15	6.0	2.0	040	1.0	6.0	2.5	5.0
92	J203	1.5	20	0010t	20	5.0t	2.0t	040	2.0	10 A	4.0	20
18	2N3459	1.5 08	20	20	0./30	18	6.0	50	101-	3.4	0.8	4.0
72	2N3821	1.5 00	15	00010	0.15	6.0	3.0	50	101-	4.0	0.5	2.5
92	MPF3821	1.5	15	00110	0.115	6.0	3.0	50	108-	4.0	0.5	2.5
18	2N3437	1.5	20	20	30	18 0	6.0	50	00.0	4.8	0.8	4.0
92	2N5457	2.0	15	50	10.15	7.0	3.0	25	0.5	6.0	1.0	5.0
92	2N5459	2.0	15	50	15	7.0	3.0	25	2.0	8.0	0 4.0	16
72	2N4221	2.0	15	20	15	6.0	2.0	30	100	6.0	2.0	6.0
92	MPF4221	2.0	15	20	13.15	6.0	2.0	30	00r — 1	6.0	2.0	6.0
72	2N4221A	2.0	15	20	15	6.0	2.0	30	oor-	6.0	2.0	6.0
72	2N3822	2.0	15	20	15	6.0	3.0	50	_	6.0	2.0	10
92	MPF3822	2.0	15	20	15	6.0	3.0	50	O Tono	6.0	2.0	10
18	2N4341	2.0	15	60	15	7.0	3.0	50	2.0	6.0	3.0	9.0
72	2N4222	2.5	15	40	15	6.0	2.0	30	_	8.0	5.0	15
72	2N4222A	2.5	15	40	15	6.0	2.0	30	_	8.0	5.0	15
92	MPF4222A	2.5	15	40	15	6.0	2.0	30	897	8.0	5.0	15
92	2N5670	3.0	15	75	15	7.0	3.0	25	2.0	8.0	8.0	20
18	2N4398	12 ^t	0.001	—xsh	_nisi	14	3.5	40	0.5	3.0	5.0	30
72	2N4118	80	0.001	5.0	10 37	3.0	1.5	40	1.0	3.0	80	240
92	MPF4118	80	0.001	5.0	1000	3.0	1.5	40	1.0	3.0	80	240
72	2N4118A	80	0.001	5.0	10 01	3.0	1.5	40	1.0	3.0	80	240
-92	MPF4118A	80	0.001	5.0	1009	3.0	1.5	40	1.0	3.0	80	240

t = typical

TABLE 2. High-Frequency Amplifiers

N-Channel JFETs

0\$			/fs	R _e Y	os	Ciss	Crss	0.0	NF	V(BR)GSS V(BR)GDO	VGS	S(off)	ID	SS
20		(B) (B)	(a)	-04	(a)	0	6	01	0.5 @	25	(V)	(n	nA)
Package TO-	Device	(mmho) Min	f (MHz)	(µmho) Max	f (MHz)	(pF) Max	(pF) Max	(dB) Max	RG = 1K f (MHz)	(V) Min	Min	Max	Min	Max
92	2N5669	1.6	100	100	100	7.0	3.0	2.5	100	25	1.0	6.0	4.0	10
92	MPF102	1.6	100	200	100	7.0	3.0	-	0.4	25	_	8.0	2.0	20
92	2N3819	1.6	100	200	_	8.0	4.0	- T	2.0	25	_	8.0	2.0	20
92	2N5668	1.0	100	50	100	7.0	3.0	2.5	100	25	0.2	4.0	1.0	5.0
92	MPF4224	1.7	200	200	200	6.0	2.0	- T	0.4	30	0.1	8.0	2.0	20
92	2N5484	2.5	100	75	100	5.0	1.0	3.0	100	25	0.3	3.0	1.0	5.0
92	2N5670	2.5	100	150	100	7.0	3.0	2.5	100	25	2.0	8.0	8.0	20

N-Channel JFETs (continued)

280		Re		R _e Y	os	Ciss	Crss	Yos	NF	V(BR)GSS V(BR)GDO	VGS	G(off)	ID	ss
Package TO-	Device	(mmho) Min	@ f (MHz)	(μmho) Max	@ f (MHz)	(pF) Max	(pF) Max	(dB) Max	@ RG = 1K f (MHz)	(V) Min	Min	V) Max		nA) Max
92	2N5246	2.5	400	100	400	4.5	1.0	03_	la.a_	30	0.5	4.0	1.5	7.0
92	MPF4223	2.7	200	200	200	6.0	2.0	5.0	200	30	0.1	8.0	3.0	18
92	2N5485	3.0	400	100	400	5.0	1.0	4.0	400	25	1.0	4.0	4.0	10
92	J305	3.0t	400	80 ^t	100	3.0 ^t	0.8 ^t	4.0t	400	30	0.5	3.0	1.0	8.0
72	2N3823	3.2	200	200	200	6.0	2.0	2.5	100	30	-	8.0	4.0	20
92	2N5486	3.5	400	100	400	5.0	1.0	4.0	400	25	2.0	6.0	8.0	20
72	2N4416	40	400	100	400	4.0	0.8	4.0	400	30	2.0	6.0	5.0	15
72	2N4416A	4.0	400	100	400	4.0	0.8	4.0	400	30	2.0	6.0	5.0	15
92	2N5245	4.0	400	100	400	4.5	1.0	4.0	400	30	1.0	6.0	5.0	8 15
92	2N5247	4.0	400	150	400	4.5	1.0	4.0	400	30	1.5	8.0	8.0	24
92	J304	4.2t	400	80 ^t	100	3.0t	0.8t	34.0t	400	30	2.0	6.0	5.0	15
52	U308	10	0.001	150	100	50	2.5	3.0t	450	25	1.0	6.0	12	60
52	U309	10	. 0.001	150	100	5.0	2.5	3.0t	450	25	1.0	4.0	12	30
52	U310	8 10	0.001	150	100	5.0	2.5	3.0t	450	25	2.5	6.0	24	60
92	J308	12 ^t	100	250 ^t	100	7.5	2.5	1.5 ^t	100	25	1.0	6.5	12	60
92	J309	12 ^t	100	250 ^t	100	7.5	2.5	1.5 ^t	100	25	1.0	4.0	12	30
92	J310	12 ^t	100	250 ^t	100	7.5	2.5	1.5 ^t	100	25	2.0	6.5	24	60
= typical	2.0	0.0	_	98	3.0	. 0	-0	81	02	2.0 15		228E	12	72

TABLE 3. Switches and Choppers

P-Channel JFETs

				0.3		20	-	V _(BR) GSS	11 45	Age	20/42	23
	8.0 5.0	rds	rds(on) VGS(off)		ID	SS	V(BR)GDO	Ciss	Crss	ton	toff	
Package	0.8 0.8	(Ω)	@ ID	(V)	(m	(A)	(V)	(pF)	(pF)	(ns)	(ns)
TO-	TO- Device		(μA)	Min	Max	Min	Max	Min	Max	Max	Max	Max
92	MPF970	100	1.0	5.0	1208	15 01	100	30	12	5.0	8.0	25
92	MPF971 0 5	250	1.0	1.0	7.00.6	2.0	80	30	12	5.0	10	120
72	2N3993	150	-61	4.0	9.5	10 01	-0.8	25	16	4.5	1.85/15	ST
72	2N3994	300	-61	1.0	5.5	2.0	-0.8	25	16	4.5	19 	00-

N-Channel JFETs

18	MFE2012	10	_	3.0	10	100	_	25	50	20	16	37
18	MFE2011	15	1.0	1.0	10	40	_ 21	25	50	20	10	20
18	2N4859A	25	-	2.0	6.0	50	_	30	10	4.0	8.0	20
92	MPF4859A	25	my T	2.0	6.0	50	1-	30	10	4.0	8.0	20
18	2N4856A	25	ayv+	4.0	10	50	0 - la	40	10	4.0	8.0	20
92	MPF4856A	25	+	4.0	10	50		40	9 10	4.0	8.0	20
18	2N4856	26	1 20	4.0	10	50	1 -1	40	10	8.0	9.0	25
92	MPF4856	25	1, 6	4.0	10	50	(5819)	40	10	8.0	9.0	25
18	2N4859	25		4.0	10	50	- 501	30	18	8.0	9.0	25
92	MPF4859	25	-	4.0	10	50	UOT	30	18	8.0	9.0	25
18	MFE2010	25	1.0	0.5	10	15		25	50	20	10	35
18	2N4391	30	1.0	4.0	10	50	150	40	14	3.5	15	20
92	MPF4391	30	1.0	4.0	10	60	130	20	10	3.5	15	20
92	2N5638	30	1.0	007	(12)	50	001	30	10	4.0	9.0	15
18	2N4091	30	1.0	5.0	10	30	691	40	16	5.0	25	40

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

TABLE 3. Switches and Choppers (continued)

N-Channel JFETs (continued)

Package TO-	Device of	rds(on)		V _{GS(off)}		IDSS		V(BR)GSS V(BR)GDO	C _{iss}	C _{rss}	ton	toff
		(Ω)	(α ID (μA)	()		61	A)	(V) Min	(pF) Max	(pF) Max	(ns) Max	(ns) Max
		Max		Min	Max	Min	Max					
92	MPF4091	30	1.0	5.0	10	30	_	40	16	5.0	25	40
92	J111	30	1.0	3.0	10	20	_	35	10 ^t	5.0 ^t	13	35
18	MFE2006	30	1.0	- 5.0	-10	30	_	-30	16	5.0	20	40
18	2N3970	30	1.0	4.0	10	50	150	40	25	6.0	20	30
92	MPF3970	30	1.0	4.0	10	50	150	40	25	6.0	20	30
18	2N5857A	40		2.0	6.0	20	100	40	9 10 W	3.5	10	40
92	MPF4857A	40	7 4	2.0	6.0	20	100	40	10	3.5	10	40
18	2N4860A	40		2.0	6.0	20	100	30	10	3.5	10	40
92	MPF4860A	40	18) ₄	2.0	6.0	20	100	30	10	3.5	10	40
18	2N4857	40	-	2.0	6.0	20	100	40	18	8.0	10	50
92	MPF4857	40	— 2B	2.0	6.0	20	100	40	18	8.0	10	50
18	2N4860	40	+ + 6	2.0	6.0	20	100	30	18	8.0	10	50
92	MPF4860	40	-	2.0	6.0	20	100	30	18	8.0	10	50
18	2N4092	50	1.0	2.0	7.0	15		40	16	5.0	35	60
92	J112	50	1.0	1.0	5.0	5.0		35	10t	5.0t	13 ^t	35
18	MFE2005	50	1.0	-2.0	-8.0	15	_	-30	16	5.0	35	60
18	2N4392	60	1.0	2.0	5.0	25	75	40	00 14	3.5	15	35
92	MPF4392	60	1.0	2.0	5.0	25	75	20	10	3.5	15	35
18	2N4858A	60	1.0	0.8	4.0	8.0	80	40	10	3.5	16	80
92	MPF4858A	60	1.0	0.8	4.0	8.0	80	40	10	3.5	16	80
18	2N4861A	60	-	0.8	4.0	8.0	80	30	10	3.5	16	80
92	MPF4861A	60	-	0.8	4.0	8.0	80	30	10	3.5	16	80
92	2N5639	60	1.0	500	(8.0) ^t	25	-	30	00 10	4.0	14	30
18	2N3971	60	1.0	2.0	5.0	25	75	40	25	6.0	30	60
18	2N4858	60	_	0.8	4.0	8.0	80	40	18	8.0	20	100
92	MPF4858	60		0.8	4.0	8.0	80	40	18	8.0	20	100
18	2N4861	60	_	0.8	4.0	8.0	80	30	18	8.0	20	100
92 28	MPF4861	60	- :	0.8	4.0	8.0	80	30	18	8.0	20	100
18	2N4093	80	1.0	1.0	5.0	80	-	40	16	5.0	60	80
18	MFE2004	80	1.0	-1.0	-6.0	8.0	(0) (-30	16	5.0	60	80
18	2N4393	100	1.0	0.5	3.0	5.0	30	40	14	3.5	15	50
92	MPF4393	100	1.0	0.5	3.0	5.0	30	20	10	3.5	15	55
92	2N5640	100	1.0	20	(6.0)	5.0	-	30	10	4.0	18	45
18	2N3972	100	1.0	0.5	3.0	5.0	30	40	25	6.0	80	100
92	MPF3972	100	1.0	0.5	3.0	5.0	30	40	25	6.0	80	100
92	J113	100	1.0	0.5	3.0	2.0	0.	35	10 ^t	5.0 ^t	13 ^t	35
92	BF246		-	0.5	14	10	300	25			THE PARTY OF THE P	121
92	BF246A	35t	1.0	1.5	4.0	30	80	25		6137	SUM IN	inen.
92	BF246B	50 ^t	1.0	3.0	7.0	60	140	25	U _	887	MZ T	81
92	BF246C	65 ^t	1.0	5.5	12	110	250	25	0	Cado	7.86	(83)
92	J107	8.0	_	0.5	4.5	100	9	25	/	168	N2 T	23
92	J108	8.0	-	3.0	10	80		25		5.0	AR T	57
92	J109	12		2.0	6.0	40		25			DAE T	23
92	J110	18		0.5	4.0	10		25		11	ME -	3.7

t = typical

FIELD-EFFECT TRANSISTORS (continued)

MOSFETs

MOSFETs are available in either depletion/enhancement or enhancement mode (in general, depietion/enhancement devices are operated in the depletion mode and are referred to as depletion devices). They are available in both N- and P-channel, and both single gate and dual gate construction. Some MOSFETs are also offered with input diode protection which reduces the chance of damage from static charge in handling.

TABLE 4. Dual Gate

These devices are especially suited for RF amplifier and mixer applications in TV tuners, radio, etc. The Dual Gate construction also allows easy AGC control with very low power.

N-Channel MOSFETs

		Channe JEETS
60	GO	co
Enhancement S	Enhancement S	Depletion S
	Dual Gate	Puckage TCO Davi
G10	08 08 G10-	
G2 O	G2 0-	
or of 2	N-CHANNEL	TT
Depletion		inhancement S
00 00		#99-40 D1

(baumana) Single Gate

N-CHANNEL

P-CHANNEL 9

N-CHANNEL 9

		Re	fs	R _e Y	os	Ciss	C _{rss}	0.0	NF	V(BR)GSS V(BR)GDO	VGS	o(off)	ID	SS
Package TO-	Device	(mmho) Min	(MHz)	(μmho) Max	(MHz)	(pF) Max	(pF) Max	(dB) Max	RG = 1K f (MHz)	(V) Min	Min	/) Max	(m Min	nA) Max
72	MFE521	8 10	0.001	UE I	-601	4.0	0.02	3.5	200	10	0.5	2.0	5.0	20
72	3N211	17	0.001	OF-	-	-	0.05	3.5	200	± 6.0	-0.2	- 5.5	6.0	40
72	3N213	15	0.01	- t	-	- 0	0.05	4.0	45	± 6.0	-0.2	-5.5	6.0	40
72	3N203	7.0	0.001	0.5	-	4.3t	0.03	4.5	200	± 6.0	-0.2	-5.0	3.0	B711
72	3N201	8.0	0.001	OF.	785	4.5 ^t	0.03	4.5	200	± 6.0	-0.2	-5.0	6.0	30
72	3N202	8.0	0.001	05	78-	4.3 ^t	0.03	4.5	200	± 6.0	-0.2	-5.0	6.0	- 30
72	MFE121	10	0.001	City.	-08	6.0	0.02	5.0	60	± 7.0	-	-4.0	5.0	30
72	MFE131	8.0	0.001	0	-08	7.0	0.05	5.0	200	± 7.0	1- /	-4.0	3.0	30
72	3N204	10	0.001	CC	-08	- 0	0.03	5.0	400	25	-0.2	-4.0	6.0	30
72	3N205	10	0.001	00	-08	-	0.03	5.0	400	25	-0.2	-4.0	6.0	30
72	3N209	10	0.001	0	-	7.0	0.03	6.0	500	± 7.0	-0.1	-4.0	5.0	30

t = typical

TABLE 5. Low-Frequency/Low-Noise

P-Channel MOSFETs

	8.0 20	Re	Yfs	Ciss	Crss	V(BR)DSS	VGS	S(th)	1888 30 VI ID	SS S
	8.0 60	21	34	- 03	5.0	0.1	0.10	V)	seess (n	nA)
Package TO-	Device	(mmho) Min	(µmho) Max	(pF) Max	(pF) Max	(V) Min	Min	Max	Min	Max
72	3N155	1.0	60	5.0	1.3	- 35	-1.5	- 3.2	SESAIAS	- 1.0
72	3N156	1.0	60	5.0	1.3	- 35	-3.0	- 5.0	188.44411	- 1.0
72	3N157	1.0	60	5.0	1.3	-35	-1.5	-3.2	OABELIS	-1.0
72	3N158	1.0	60	5.0	1.3	- 35	-3.0	-5.0	SKRENS	- 1.0
72	3N158A	1.0	60	5.0	1.3	- 25	-2.0	- 6.0	TARCALIN	- 20
18	MFE823	1.0	0.0	6.0	1.5	- 50	-3.0	-5.0	EITL	- 0.25
N-Channel	MOSFETs		20	01	2	0.0			1842-11	28
18	2N3796	0.4	1.8	7.0	0.8	25		-7.0	2.0	6.0
18	MFE825	0.5		4.0	0.7	20			1.0	25
72	2N4351	1.0		5.0	1.3	25	1.0	5.0	UDAS ILL	10
72	3N169	1.0		5.0	1.3	25	0.5	1.5	1011	10
72	3N170	1.0	-	5.0	1.3	25	1.0	2.0	0010	10
72	3N171	1.0	-	5.0	1.3	25	1.5	3.0	80	10
18	2N3797	1.5		8.0	0.8	25		-7.0	2.0	6.0

Small-Signal TMOS

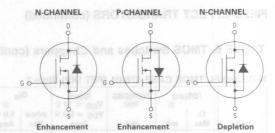


TABLE 6. TMOS Switches and Choppers

N-CHANNEL	TMOS	TO-226AA,	Style	5

25 20	rps		oo: Vg	S(th)	V(BR)DSS	8 Ciss	Crss	ton	toff
Device	Ω Max	I _D	008 Min 00	Max	δ σ V	pF Max	pF Max	ns Max	ns Max
VN0300L	1.2	1.0	08 0.8 08	2.5	8 30	0.0 100	25	30	30
2N7000	5.0	0.5	0.8	3.0	60	60	08/ 5.0	10	10
BS170	5.0	0.2	0.8	3.0	60	25 Typ	3.0 Typ	10	10
VN0610LL	5.0	0.5	0.8	2.5	60	60	5.0	10	10
VN1706L	6.0	0.5	0.8	2.0	170	125	20	16	30
VN2406L	6.0	0.5	0.8	2.0	240	125	20	16	30
BSS89	6.4	0.25	nec 1.0	2.7	200	90	3.5	15.0	15
BS107A	6.408	0.25	1.0	3.0	200	70 Typ	6.0 Typ	15	15
MPF9200	6.4	0.25	oor 1.0 oz	4.0	200	90	sor 10	15	S1 15
2N7008	7.5	0.5	1.0	2.5	60	50	5.0	20	20
VN2222LL	7.5	0.5	0.6	2.5	60	60	5.0	10	10
BS108	8.5	0.1	0.3	2.0	200	90	8.0	8.0 Typ	10 Ty
VN1710L	10	0.5	0.8	2.0	170	125	20	16	50
VN2410L	10	0.5	0.8	2.0	240	125	20	16	50
MPF4150†	12	0.1	1.0	6.0	150	125	15	_	50000
BS107	14	0.2	1.0	3.0	200	70 Typ	6.0 Typ	15	15
MPF350	35	0.1	1.0	4.0	350	125	20	20	20
2N7007	45	0.05	1.0	2.5	240	30	10	30	30
MPF500	50	0.1	1.0	4.0	500	125	20	20	20
MPF480	80	0.01	0.5	3.0	80	8.0	7.0	20	20
MPF481	140	0.01	0.5	3.0	180	8.0	7.0	20	20
-CHANNEL TMO	S TO-226A	A, Style 5	00+						
VP0300L	2.5	1.0	2.0	4.5	30	150	60	30	30
BS170P	5.0	0.2	1.0	3.5	60	110	25	15	15
BS250	14	0.2	1.0	3.5	45	150	25	10	10
-CHANNEL TMC	S TO-226AI	E (1 WATT)	, Style 22	0.0	86				Barasa
MPF930	1.4	1.0	1.0	3.5	35	70	18	15	15
MPF960	1.7	1.0	1.0	3.5	60	70	18	15	15
MPF6659	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
MPF990	2.0	1.0	1.0	3.5	90	70	18	15	15
MPF6660	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
MPF6661	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0
MPF910	5.0	0.5	0.8	2.5	60	50	10	10	10
MPF89	6.4	0.25	1.0	2.7	200	90	3.5	15	15
-CHANNEL TMO	S TO-226AE	(1 WATT)	, Style 22	14-15	7.7	And the	- 9		
MPF930P	1.4	1.0	1.0	3.5	35	150	50	30	30
MPF960P	1.7	1.0	1.0	3.5	60	150	50	30	30
MPF990P	2.0	1.0	1.0	3.5	90	150	50	30	30

TABLE 6. TMOS Switches and Choppers (continued)

N-CHANNEL TMOS CASE 370-01 (FET DIP) Style 1

	rps	(on)	V _{(BR)DSS} Volt	I _{D(on)} V _{GS} = 10 V	G	fs @	C _{iss} @ 25 V	Coss @ 25 V	C _{rss} @ 25 V	td(on)	tr	td(off)	tf
Device	Ω Max	mA	Min	V _{DS} = 5.0 V Amp	mhos Min	5.0 V Amp	pF Max	pF Max	pF Max	ns Max	ns Max	ns Max	ns Max
IRFD120	0.3	600	100	1.3	0.9	0.6	600	400	100	40	70	100	70
IRFD123	0.4	600	60	1.1	0.9	0.6	600	400	100	40	70	100	70
IRFD110	0.6	800	100	1.0	0.8	0.8	200	100	25	20	25	25	20
IRFD113	0.8	800	60	955 8.0 Ciss	0.8	0.8	200	100	25	20	25	25	20
IRFD220	0.8	400	200	0.8	0.5	0.4	600	300	80	40	60	100	60
IRFD223	1.2	400	150	0.7	0.5	0.4	600	300	80	40	60	100	60
IRFD210	1.5	600	200	ogn 0.6	0.3	0.5	150	80	25	15	25	15	15
IRFD213	2.4	300	0.8 150	0.45	0.3	0.5	150	80	25	150.0	25	15	15
IRFD1Z0	2.4	250	100	0.5	0.25	0.25	70	30	10	20	25	25	20
IRFD1Z3	3.2	250	60	08 0.4	0.25	0.25	70	30	e 10	20	25	25	20

P-CHANNEL TMOS CASE 370-01 (FET DIP) Style 1

IRFD9120	0.6	800	00 100	881 1.0	0.8	0.8	450	350	100	50	100	100	100
IRFD9123	0.8	800	8 60	0.8	0.8	0.8	450	350	100	50	100	100	100
IRFD9110	1.2	300	100	VT 010.7	0.6	0.3	250	100	35	30	60	40	40
IRFD9112	1.2	300	100	0.6	0.6	0.3	250	100	35	30	60	40	40

N-CHANNEL TMOS TO-205AD. Style 6

	90 Typ	rDS	(on)	VGS	6(th)	V(BR)DSS	Ciss	C _{rss}	ton	toff
Devic	e 81	Ω Max	I _D	Min	Max	V Min	pF Max	pF Max	ns Max	ns Max
VN0300B	00	1.2	1.0	0.8	2.5	30	100	25	30	30
MFE930		1.4	1.0	1.0	3.5	35	70	18	15	15
MFE960	0.00	1.7	1.0	1.0	3.5	60	70	18	15	15
2N6659	US.	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
MFE990	06	2.0	1.0	1.0	3.5	90	70	18	15	15
2N6660	- 05	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
2N6661	03	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0
MFE910	143	5.0	0.5	0.8	2.5	60	50	10	10	10
VN1706B		6.0	0.5	0.8	2.0	170	125	20	16	30
VN2406B	90	6.0	0.5	0.8	2.0	240	125	20	16	30
MFE9200††	- 13	6.4	0.25	1.0	4.0	200	90	10	15	15
VN1710B	(P)	10	0.5	0.8	2.0	170	125	20	16	57
VN2410B		10	0.5	0.8	2.0	240	125	20	16	57
MFE4150†	ě1	12	0.1	1.0	6.0	150	125	15	11-	PE930
MFE350	ät	35	0.1	1.0	4.0	350	125	20	20	20
MFE500	5.0	50	0.1	1.0	4.0	500	125	20	20	20
-CHANNEI	L TMOS	TO-205AD). Style 6	- 08	3.5	0.1	-0.7	2.0		00999

MFE930P	1.4	1.0	1.0	3.5	35	150	50	30	30
MFE960P	1.7	1.0	1.0	3.5	60	150	50	30	30
MFE990P	2.0	1.0	1.0	3.5	90	150	50	30	30
VP0300B	2.5	1.0	2.0	4.5	30	150	60	30	30

[†]Depletion Mode ††TO-18 — Case Style 12

N-CHANNEL TMOS TO-205AF, Style 6

	rDS	(on)	VG	S(th)	V(BR)DSS	Ciss	C _{rss}	ton	toff
Device	Ω Max	ID A	Min	Max	V Min	pF Max	pF Max	ns Max	ns Max
2N6796	0.18	8.0	2.0	4.0	100	900	150	105	85
IRFF130	0.18	8.0	2.0	4.0	100	800	150	200	250
IRFF133	0.25	7.0	2.0	4.0	60 60	800	150	200	250
IRFF120 38AO	0.3	6.0	2.0	4.0	100	600	100	110	170
2N6798	0.4	5.5	2.0	4.0	200	900	150	80	90
IRFF123	0.4	5.0	2.0	4.0	60	600	100	110	8 170
IRFF230	0.4	5.5	2.0	4.0	200	150	150	80	90
2N6782	0.6	3.5	2.0	4.0	100	200	25	40	45
IRFF110	0.6	3.5	2.0	4.0	100	200	25	45	45
IRFF233	0.6	4.5	2.0	4.0	150 0	800	150	80	90
2N6790	0.8	3.5	2.0	4.0	200	600	80	90	100
IRFF113	0.8	3.0	2.0	4.0	60	200	25	45	45
IRFF220	0.8	3.5	2.0	4.0	200	600	80	100	160
2N6800	1.0	3.0	2.0	4.0	400	900	80	65	90
IRFF330	1.0	3.5	2.0	4.0	400	900	80	65	90
IRFF223	1.2	3.0	2.0	4.0	150	600	80	100	160
MFE930	1.4	1.0	1.0	3.5	35	70	18	15	15
2N6784	1.5	2.25	2.0	4.0	200	200	25	35	50
2N6802	1.5	3.5	2.0	4.0	500	900	60	60	85
IRFF210 mulco emo?	1.5	2.2	2.0	4.0	200	150	25	40	30
IRFF333	1.5	3.0	2.0	4.0	350	900	80	65	90
IRFF430	1.5	2.75	2.0	4.0	500	800	60	60	85
IRFF313	1.5	1.15	2.0	4.0	350	150	15	30	25
MFE960	1.7	5 1.0	1.0	3.5	60	70	18	15	15
2N6659	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
IRFF433	2.0	2.25	2.0	4.0	450	800	60	60	85
MFE960	2.0	1.0	1.0	3.5	90	70	18	15	15
IRFF213	2.4	1.8	2.0	4.0	150	150	25	40	30
2N6660	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
2N6786*	3.6	1.25	2.0	4.0	400	200	15	35	65
IRFF310	3.6	1.35	2.0	4.0	400	150	15	30	25
2N6661	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0
-CHANNEL TMOS	TO-205AF	Style 6			101-11-1		14	1	makey no
IRFF9120	0.6	-4.0	2.0	4.0	- 100	450	100	150	200
IRFF9123	0.8	-3.5	2.0	4.0	-60	450	100	151	200

Bipolar Devices

The trend in electronic system design is toward the use of integrated circuits — to reduce component cost, assembly cost, and equipment cost. But ICs still aren't all things to all people, and for those circuit designs where ICs are not available, there is a noticeable swing towards the use of multiple devices.*

Motorola is reacting to this expanding market requirement by making available a large selection of quad, dual, Darlington transistors, and diode arrays for off-the-shelf delivery. The chips used in the Quad and Dual transistors are those that have emerged as the most popular ones for discrete transistor applications. But even beyond that, Motorola offers its entire vast repertoire of discrete small-signal transistors for multiple-device packaging. For special applications where the devices in these tables might not quite fit the design requirements, special configurations can be supplied with quick turnaround time and at low premiums.



*Multiple devices, as described here, encompass two or more transistor or diode chips in a single package. Included in this definition are the Darlington transistors which consist of two interconnected devices functioning as a single-stage amplifier.

Specification Tables

The following short form specifications include Quad and Dual bipolar transistors listed in alphanumeric order. Some columns denote two different types of data indicated by either **bold** or *italic* typeface. See key and headings for proper identification. This applies to Table 1 and 2 of this section only.

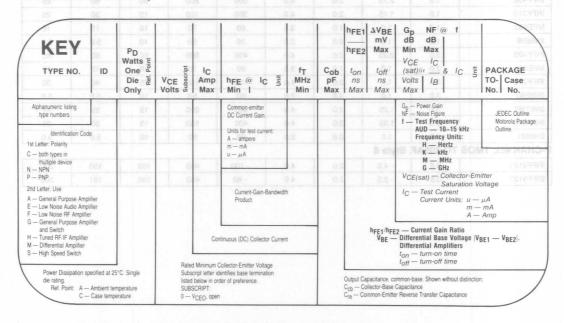


TABLE 1. Bipolar Transistors — Quads

			PD	yeve range Vm and carri						hFE1 hFE2	ΔVBE mV Max	G _p dB Min	Max Typ*			
TYPE NO.	0.01	lD	Watts to One Only	VCE- Volts	I _C Amp Max	hFE@ Min	lc is	f _T MHz Min Typ*	C _{ob} pF Max Typ*	ton ns Max Typ*	toff ns Max Typ*	VCE (sat) (e Volts Max	1c	IC N	PAC TO- No.	KAGE Case No.
MHQ918		NF	0.65 A	15 O	0.05	20	3.0 m	600	2.0			Asta	6.0	60 M	116	632
MHQ2222†		NG	0.65 A	40 O	0.5	100	150 m	200	8.0	25*	250*	0.4	10	150 m	116	632
MHQ2369		NS	0.5 A	15 0	0.5	40	10 m	450	4.0	9.0*	15*	0.25	10	10 m	116	632
MHQ2906		PG	0.65 A	40 O	0.6	40	150 m	200	8.0	30*	100*	0.4	10	150 m	116	632
MHQ2907†		PG	0.65 A	40 O	0.6	100	150 m	200	8.0	30*	100*	0.4	10	150 m	116	632
MHQ3467†	160 m	PS	0.9 A	40 O	1.0	20	500 m	125	25	40	90	0.5	10	500 m	116	632
MHQ3546	111-00-1	PS	0.5 A	12 0	0.2	30	10 m	600	6.0	0.15*	25*	0.25	10	10 m	116	632
MHQ3798		PA	0.5 A	40 0	0.05	150	0.1 m	60	4.0	0 8		4 5.0	3.0*	AUD	116	632
MHQ4002A	GU	NS	0.75 A	45 0	1.5	30	500 m	200	10	40	75	0.52	10	500 m	116	632
MHQ4013††		NS	0.75 A	40 O	1.5	35	500 m	200	10	35	60	0.52	10	500 m	116	632
MHQ4014		NS	0.75 A	45 O	1.5	35	500 m	200	10	35	60	0.52	10	500 m	116	632
MHQ6001		CA	0.65 A	-30 O	0.5	40	150 m	200	8.0	30*	225*	0.4	10	150 m	116	632
MHQ6002	111 001	CA	0.65 A	30 O	0.5	100	150 m	200	8.0	30*	225*	0.4	10	150 m	116	632
MPQ1000		NA	0.65 A	20 O	0.5	50	10 m	175	8.0	0 0	220	0.5	10	150 m	110	646
MPQ2221		NA	0.65 A	30 O	0.5	40	150 m	200	8.0	25*	250*	0.4	10	150 m		646
MPQ2221A		NA	0.65 A	30 O	0.5	40	150 m	200	8.0	25*	250*	0.4	10	150 m		646
MPQ2222		NA	0.65 A	30 O	0.5	100	150 m	200	8.0	25*	250*	0.4	10	150 m	1	646
MPQ2222A		NA	0.65 A	30 O	0.5	100	150 m	200	8.0	25*	250*	0.4	10	150 m		646
MPQ2369	m St	NS	0.5 A	15 O	0.5	40	10 m	450	4.0	9.0*	15*	0.25	10	10 m		646
MPQ2483		NA	0.625 A	40 0	0.05	150	1.0 m	50	4.0	9.0	15	0.25	3.0*	AUD		
MPQ2484		NA	0.625 A	40 O	0.05	300	1.0 m	50	80.0	0 0		0.4.4	2.0*	AUD		646 646
MPQ2906		PA	0.65 A	40 0	0.05	40	150 m	200	8.0	30*	100*	0.4	10	150 m		646
MPQ2906A		PA	0.65 A	60 O	0.6	40	150 m	200	8.0	30*	100*	0.4	10	150 m		646
MPQ2907		PA	0.65 A	40 O	0.6	100	150 m	200	8.0	30*	100*	0.4	10	150 m	anm.	646
		PA		111				1000	10.00							
MPQ2907A			0.65 A		0.6	100	150 m	200	8.0	30*	100*	0.4	10	150 m	2.1	646
MPQ3303 MPQ3467		NS PS	0.65 A 0.75 A	12 O 40 O	1.0	40 20	300 m 500 m	400 125	10 25	15 40	25 90	0.7	10	1.0 A 500 m		646
MPQ3546		PA	0.75 A	12 0	0.2	30	10 m	600	6.0	15*	25*	0.25	10	10 m		646 646
MPQ3725†		NS	1.0 A	40 0	1.0	25	500 m	250	10	35	60	0.25	10	500 m		646
MPQ3725A		NS	1.0 A	50 O	1.0	30	500 m	200	10	3.5	60	0.45	10	500 m		646
		-	4134	Hotel Control	15000	77			753			0.000	19.			14.000
MPQ3762		PS	0.75 A	40 0	1.5	35	150 m	150	15	50	120	0.55	10	500 m	PE NO	646
MPQ3798		PA	0.625 A	40 0	0.05	150	0.1 m	60	4.0	1 1	lov :	elc	3.0*	AUD		646
MPQ3799 MPQ3904		PA NG	0.625 A 0.5 A	60 O 40 O	0.05	300 75	0.1 m	60	4.0	37*	1001	0.0	2.0*	AUD		646
MPQ3904		PG	0.5 A	40 0	0.2	75	10 m	200	4.0	43*	136*	0.2	10	10 m	-	646
MPQ6001		CG	0.5 A	30 O	0.2	40	150 m	200	8.0	30*	155* 225*	0.25	10	10 m		646 646
950 01	111 01	133	1000	6 100	0.0	1.71		DOM:	30.0	-		0.01	100			read of
MPQ6002		CG	0.65 A	30 0	0.5	100	150 m	200	8.0	30*	225*	0.4	10	150 m		646
MPQ6100		CA	0.5 A	40 0	0.05	75	1.0 m	50	4.0	Q 8	1	8.88	4.0*	AUD		646
MPQ6100A		CA	0.5 A	45 0	0.05	150	1.0 m	50	4.0	000	005	an n	4.0*	AUD		646
MPQ6501 MPQ6502		CG	0.65 A	30 O	0.5	40	150 m	200	8.0	30*	225*	0.4	10	150 m		646
MPQ6502 MPQ6600		CA	0.65 A 0.5 A	40 O	0.5	100 75	150 m	50	8.0	30*	225*	0.4	10 4.0*	150 m		646
PALLED	111.01	143.1	5.0 1	7 2.0	115	100	0.00	1714	50.00			250.33	0.000	AUD		646
MPQ6600A		CA	0.5 A	45 0	0.05	150	1.0 m	50	4.0	0 8		0.25	4.0	1.0 m		646
MPQ6700	W 09	CA	0.5 A	40 0	0.2	70	10 m	200	4.5	0 .8		0.25	4.0	1.0 m		646
MPQ6842		CA	0.75 A	40 0	0.5	70	10 m	300	4.5	45	150	0.15	10	0.5 m	9	646
MPQ7041		NA	0.75 A	150 O	0.5	25	1.0 m	50	5.0	2		0.5	10	20 m		646
MPQ7042		NA	0.75 A	200 O	0.5	25	1.0 m	50	5.0	N 5		0.5	10	20 m		646
WII Q7040	1111001	NA	0.75 A	250 O	0.5	25	1.0 m	50	5.0	7. 9	- 17	0.5	10	20 m	1	646
MPQ7091		PA	0.75 A	150 O	0.5	25	1.0 m	50	5.0	0 10		0.5	10	20 m		646
MPQ7092		PA	0.75 A	200 O	0.5	25	1.0 m	50	5.0	0		0.5	10	20 m		646
MPQ7093		PA	0.75 A	250 O	0.5	35	10 m	50	5.0	100	1 1	0.5	10	20 m	7	646
MQ918		NA	0.55 A	15 O	0.05	50	3.0 m	600	1.7	7.5		DO D	6.0	60 M		607
1410000		NA	0.4 A	45 O	0.03	150	1.0 m	260*	6.0	G 01	1 7	9.35	- ASM	1	1	607
MQ982		PA	0.4 A	50 O	0.6	40	150 m	200	8.0	0 0	- 1	0.5	10	150 m		607

tH, HX, and HXV Suffixes also available.

†H, HX, and HXV Suffixes also available.

†HMHQ4013 is electrically equivalent to MHQ3725.

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

TABLE 1. Bipolar Transistors — Quads (continued)

		0	e Sh		941						hFE1	ΔVBE mV	G _p	NF @	f		
TYPE NO.	i o	I _D	PD Watts triod.		Subscript	I _C Amp Max	hFE@ Min	i lc š	f _T MHz Min Typ*	C _{ob} pF Max Typ*	ton ns Max Typ*	Max toff ns Max Typ*	VCE (sat) (a Volts Max	Max Typ*	IC In	PAC TO- No.	KAGE Case No.
MQ1120	m par	PA	0.4 A	30	0	0.5	50	10 m	200	8.0	0 1		0.1	10	10 m	30	607
MQ1129		NA	0.4 A	30	0	0.5	100	10 m	200	8.0	100		0.15	10	10 m	15	607
MQ2218		NA	0.4 A	30	0	0.5	40	150 m	200	8.0	0 0	N	0.4	10	150 m	84	607
MQ2218A		NA	0.6 A	40	0	0.5	40	150 m	200	8.0	0		0.4	10	150 m	1	607
MQ2219		NA	0.6 A	30	0	0.5	100	150 m	200	8.0	0 0		0.3	10	150 m	45	607
MQ2219A	A 5.1	NA	0.4 A	30	0	0.5	100	150 m	200	8.0	-		0.3	10	150 m	1.0	607
MQ2369	QU.	NS	0.4 A	15	0	0.5	40	10 m	500	4.0	15	20	0.25	10	10 m	01	607
MQ2484		NE	0.4 A	60	0	0.03	100	10 u	260*	6.0	0 8			3.0	AUD	8.0	607
MQ2905A		PG	0.4 A	60	0	0.6	100	150 m	300	8.0	42	130	0.4	10	150 m	115	607
MQ3251		PA	0.4 A	40	0	0.05	100	10 m	300	6.0	0 8		0.25	10	10 m	1 1	607
MQ3467		PS	0.4 A	40	0	1.0	20	500 m	150	20	40	110	0.5	10	500 m	- 6	607
MQ3725	en 652.5	NS	0.4 A	40	0	1.0	50	100 m	200	10	45	75	0.26	10	100 m		607
MQ3762		PS	0.4 A	40	0	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A	24	607
MQ3798		PA	0.4 A	60	0	0.05	150	100 u	450*	4.0	0 0		0.2	10	1.0 m	10	607
MQ6001		CG	0.4 A	30	0	0.5	40	150 m	200	8.0	60	350	0.4	10	150 m	Art	607
MQ7001		PA	0.4 A	30	0	0.6	70	1.0 m	200	8.0	0 0	6	0.4	10	150 m	.61	607
MQ7003		NA	0.4 A	40	0	0.05	50	10 m	200	6.0	0 0	8	0.35	10	1.0 m	ACC	607
MQ7004	- DI	NA	0.4 A	13	0	0.2	30	10 m	675*	4.0			0.4	10	10 m		607
MQ7007		PA	0.4 A	40	0	0.2	30	1.0 m	300	8.0	0 0		1.0	10	50 m	5	607
MQ7021		CG	0.4 A	40	0	0.05	50	10 m	200	6.0	28*	72*	0.35	10	10 m		607
2N5146		PA	0.4 A	40	0	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A	24	607

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

TABLE 2. Bipolar Transistors — Duals

	880 m 10 m 500 m 500 m		2.0 25.0 PD 0			as 0.8 0.7 0.1	008		20 30 30 30 30	1.0	hFE2	ΔV _{BE} mV Max	G _p dB Min	NF @ dB Max Typ*	f		
TYPE NO.	SOD m	ID	One Die Only	V _{CE} - Volts	Subscript	I _C Amp Max	hFE@ Min	a lc =	f _T MHz Min Typ*	Cob pF Max Typ*	ton ns Max Typ*	toff ns Max Typ*	VCE (sat) @ Volts Max	/C 	IC H	PAC TO- No.	CAGE Case No.
BFX11 BFX15 BFX36 BFY81 MD708 MD708A	16 m 160 m 150 m NUD NUD	PM NM PM NM NG	0.4 A 0.5 A 0.4 A 0.4 A 0.55 A	45 40 60 45 15	000000	0.05 0.5 0.05 0.03 0.2 0.2	80 60 100 100 40 40	50 m 100 u 10 u 100 u 10 m 10 m	130 50 40 60 300 300	8.0 15 6.0 6.0 5.0	0.8 0.9 0.9 0.8 35 0.9	5.0 5.0 3.0 10 75 5.0	0.25 1.0 0.25 0.35 0.2 0.2	20 10 20 10 10	50 m 1.0 m 10 m 1.0 m 10 m 10 m	78 78 78 78 78	654 654 654 654 654
MD708B MD708BF MD918	1.0 m	NM NM NF NM	0.35 A 0.55 A 0.35 A 0.55 A 0.55 A 0.35 A	15 15 15 15 15 15	000000	0.2 0.2 0.2 0.05 0.05 0.05	40 40 40 50 50 50	10 m 10 m 10 m 3.0 m 3.0 m 3.0 m	300 300 300 600 600 600	5.0 5.0 5.0 1.7 1.7	0.9 0.8 0.8 0.9	5.0 10 10 5.0 5.0	0.2 0.2 0.2	10 10 10 6.0 6.0 6.0	10 m 10 m 10 m 60 M 60 M	20 00 A00 00 31	610A 654 610A 654 654 610A
	20 m 20 m 20 m 20 m 20 m 20 m	NM NF PA CA CA	0.55 A 0.35 A 0.4 A 0.575 A 0.575 A 0.55 A	15 15 50 20 30 15	000000	0.05 0.05 0.6 0.2 0.5 0.2	50 50 40 25 40 25	3.0 m 3.0 m 150 m 10 m 150 m 10 m	600 600 200 250 200 200	1.7 1.7 8.0 8.0 4.0	0.8	10 18 18 18 18	0.5 0.5 0.5 0.3	6.0 6.0 10 10 10	60 M 60 M 150 m 50 m 150 m 10 m	1.2 1.3 1.1 1.2 1.2 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3	654 6104 6104 654 654 654
MD1120F MD1121 MD1121F MD1122F MD1122F MD1123	m Oel	NM NM NM NM NM	0.35 A 0.575 A 0.35 A 0.575 A 0.35 A 0.575 A	30 30 30 30 30 40	000000	0.5 0.5 0.5 0.5 0.5 0.5	50 50 50 50 50 50	10 m 10 m 10 m 10 m 20 m	200 200 200 200 200 200 250	8.0 8.0 8.0 8.0 8.0 4.0	0.8 0.9 0.9 0.9 0.9 0.9	10 10 10 5.0 5.0	0.1 0.1 0.1 0.1 0.1 0.25	10 10 10 10 10 10	10 m 10 m 10 m 10 m 10 m	nd kiXV 3 is ele imms 3	610 <i>A</i> 654 654 654 654 654

Some columns show 2 different types of data indicated by either bold or italic typefaces. See key and headings.

TABLE 2. Bipolar Transistors — Duals (continued) on also — anotal answ Tuslogia & BLSAT

		10 F	M nM							hFE1 hFE2	ΔVBE mV Max	G _p dB Min	Max Typ*	f		
Seco Of OM	1660	ID	One Die Only	VCE- Volts dus	Amp Max	h _{FE} (@ Ic \$	f _T MHz Min Typ*	Cob pF Max Typ*	ton ns Max Typ*	toff ns Max Typ*		I _C 8	IC N	TO- No.	KAGE Case No.
MD1130		PM	0.575 A	40 O	0.0.2	100	100 u	200	4.0	0.9	5.0	0.25	10	10 m		654
MD1130F		PM	0.35 A	40 0	0.2	100	100 u	200	4.0	0.9	5.0	0.25	, 0	10 m	3/	610/
MD1132		NM	0.3 A	15 0	0.05	50	1.0 m	600	1.7	0.9	5.0	0.4	1.00	10 m		654
MD2060F		NM	0.35 A	60 O	0.5	30	0.1 m	100	15	0.9	5.0	0.1	8.0	10 m		610
MD2218		NG	0.575 A	30 O	0.5	40	150 m	200	8.0	60	350	0.4	, 0	150 m		654
MD2218A	m Do	NG	0.575 A	30 O	0.5	40	150 m	200	8.0	45	310	0.3	10	150 m		654
MD2218AF		NG	0.35 A	30 O	0.5	40	150 m	200	8.0	045	310	0.3	10	150 m		610
MD2218F		NG	0.35 A	30 O	0.5	40	150 m	200	8.0	60	350	0.4	10	150 m		610
MD2219		NG	0.575 A	30 O	0.5	100	150 m	200	8.0	60	350	0.4		150 m	96	654
MD2219A		NG	0.575 A	30 O	0.5	100	150 m	200	8.0	45	310	A 0.3		150 m		654
MD2219AF		NG	0.35 A	30 O	0.5	100	150 m	200	8.0	45	310	0.3	100000	150 m		610
MD2369	70 m	NS	0.55 A	15 0	0.5	40	10 m	500	4.0	15	20	0.25	10	10 m		654
MD2369A		NM	0.55 A	15 O	0.5	40	10 m	500	4.0	0.9	5.0	0.25	10	10 m		654
MD2369AF		NM	0.35 A	15 O	0.5	40	10 m	500	4.0	0.9	5.0	0.25	10	10 m		610
MD2369B		NM	0.55 A	15 0	0.5	40	10 m	500	4.0	0.8	10	0.25	70	10 m		654
MD2369BF		NM	0.35 A	15 0	0.5	40	10 m	500	4.0	0.8	10	0.25	100	10 m		610
MD2904		PG	0.575 A	40 O	0.6	40	150 m	200	8.0	45	130	0.4		150 m		654
MD2904A	50 m	PG	0.575 A	60 O	0.6	40	150 m	200	8.0	45	130	0.4	10	150 m		654
MD2904AF		PG	0.35 A	60 O	0.6	40	150 m	200	8.0	45	130	0.4	10	150 m		610
MD2904F		PG	0.35 A	40 O	0.6	40	150 m	200	8.0	45	130	0.4	10	150 m		610
MD2905		PG	0.575 A	40 O	0.6	100	150 m	200	8.0	45	130	0.4	10	150 m		654
MD2905A		PG	0.575 A	60 O	0.6	100	150 m	200	8.0	45	130	0.4		150 m		654
MD2905AF		PG	0.35 A	60 O	0.6	100	150 m	200	8.0	45	130	0.4		150 m		610
MD3250	gu	PA	0.575 A	40 O	0.2	50	1.0 m	200	6.0	10	5P- 1	0.25	10	10 m		654
MD3250A		PM	0.575 A	40 O	0.2	50	1.0 m	200	6.0	0.9	5.0	0.25	10	10 m		654
MD3250AF		PM	0.35 A	40 O	0.0.2	50	1.0 m	200	6.0	0.9	5.0	0.25	10	10 m		610
MD3251		PA	0.575 A	40 O	0.2	100	1.0 m	250	6.0	0	100	0.25	10	10 m		654
MD3251A		PM	0.575 A	40 0	0.2	100	1.0 m	250	6.0	0.9	5.0	0.25	10	10 m		654
MD3251AF		PM	0.35 A	40 0	0.2	100	1.0 m	250	6.0	0.9	5.0	0.25	10	10 m		610
MD3251F	42.03	PA	0.35 A	40 0	0.2	100	1.0 m	250	6.0	0	100	0.25	10	10 m		610/
MD3409		NM	0.575 A	30 O	0.5	50	10 m	200	8.0	0.8	10	0.15	10	10 m		654
MD3410		NM	0.575 A	30 O	0.5	50	10 m	200	8.0	0.9	10	0.15	10	10 m		654
MD3467		PS	0.6 A	40 O	1.4	20	500 m	150	20	40	110	0.5	10	1962 3 3 3 3 3 3		654
MD3725		NS	0.6 A	40 O	1.0	50	100 m	200	10	45	75	0.26	10			654
MD3725F		NS	0.35 A	40 0	1.0	50	100 m	200	10	45	75	0.26		100 m		610/
MD3762	-	PS	0.6 A	40 O	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A		654
MD3762F		PS	0.35 A	40 O	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A		610
MD5000		PH	0.3 A	15 0	0.05	20	3.0 m	600	1.7	10	45	15	1.359			654
MD5000A		PM	0.3 A	15 0	0.05	20	3.0 m	600	1.7	0.9	5.0	15	1392	200 M		654
MD5000B		PM	0.3 A	15 0	0.05	20	3.0 m	600	1.7	0.8	10	15	100	100000000000000000000000000000000000000		654
MD6001 MD6001F		CG	0.575 A 0.35 A	30 O	0.5	40	150 m	200	8.0	60	350	0.4	10			654
						-	150 m		8.0	60	350	0.4	10	150 m		610.
MD6002		CG	0.575 A	30 O	0.5	100	150 m	200	8.0	60	350	0.4	10	150 m		654
MD6002F		CG	0.35 A	30 O	0.5	100	150 m	200	8.0	60	350	0.4		150 m		610
MD6003		CA	0.575 A	30 O	0.5	70	150 m	200	8.0	19	10	0.4		150 m		654
MD6100 MD6100F		CA	0.5 A	45 O 45 O	0.05	100	0.1 m	30	4.0	10	1	0.25	, 0	1.0 m		654
MD7000		NA	0.35 A 0.575 A	45 O 30 O	0.05	100	0.1 m 150 m	30 200	4.0 8.0	0		0.25	10	10 m		610
						-					10		10	150 m		654
MD7001		PA	0.6 A	30 O	0.6	70	150 m	200	8.0	0	10	0.4	10	150 m	24	654
MD7001F		PA	0.35 A	30 O	0.6	70	150 m	200	8.0	19-1	8	0.4	, 0	150 m		610
MD7002		NA	0.575 A	40 0	0.03	40	100 u	200	6.0	10	10	0.35	10	10 m		654
MD7002A		NM	0.575 A	40 0	0.03	40	100 u	200	6.0	0.75	25	0.35	10	10 m		654
MD7002B		NM	0.575 A	40 0	0.03	40	100 u	200	6.0	0.85	15	0.35	1.0	10 m		654
MD7003	H 001	NA	0.55 A	40 O	0.05	50	10 m	200	6.0	142	70	0.35	10	1.0 m		654

Some columns show 2 different types of data indicated by either bold or italic typefaces. See key and headings.

TABLE 2. Bipolar Transistors — Duals (continued) (0) alsula — anotaianan Thalogia

TYPE NO.		lp	PD Watts One Die Only		Subscript	IC Amp Max	hFE@	lc and	f _T MHz Min Typ*	C _{ob} pF Max Typ*	hFE1 hFE2 ton ns Max Typ*	AVBE mV Max toff ns Max Typ*	Gp dB Min VCE (sat) @ Volts Max	NF @ dB Max Typ* IC W &	f IC nuit	PAC TO- No.	CKAGE Case No.
MD7003A	m ol	NM	0.55 A	40	0	0.05	50	10 m	200	6.0	0.75	25	0.35	10	1.0 m		654
MD7003AF		NM	0.35 A		0	0.05	50	10 m	200	6.0	0.75	25	0.35	10			610A
MD7003B		NM	0.55 A	40	0	0.05	50	10 m	200	6.0	0.85	15	0.35	10	1.0 m		654
MD7004		NA	0.55 A	13	0	0.2	30	10 m	675*	4.0		18	0.4	10	10 m	-	654
MD7005		PA	0.55 A	12	0	0.05	30	3.0 m	650	3.0		36	0.4	10	10 m		654
MD7007		PA	0.575 A	40	0	0.2	30	1.0 m	300	8.0	9	18	A 1.0	10	50 m		654
MD7007A		PM	0.575 A	50	0	0.2	30	1.0 m	300	8.0	0.75	20	1.0	10	50 m	3,4	654
MD7007B		PM	0.575 A	60	0	0.2	30	1.0 m	300	8.0	0.85	10	1.0	10	50 m		654
MD7007BF		PM	0.35 A	40	0	0.2	30	1.0 m	300	8.0	0.85	10	1.0	10	50 m		610
MD7007F		PA	0.35 A	40	0	0.2	30	1.0 m	300	8.0	0	18	1.0	10	50 m		610
MD7021		CG	0.55 A		0	0.05	50	10 m	200	6.0	28*	72*	0.35	10	10 m	- 3	654
MD7021F	IN DE	CG	0.35 A	40	0	0.05	50	10 m	200	6.0	28*	72*	0.35	10	10 m		610/
MD8001		NM	0.575 A	40	0	0.03	100	1.0 m	260*	2.6*	0	15	A 88.0	198	ă .		654
MD8002		NM	0.575 A	40	0	0.03	100	1.0 m	260*	2.6*	0	15	9.35 A	AM	4	- 30	654
MD8003		NM	0.575 A		0	0.03	100	1.0 m	260*	2.6*	0	15	A 88.0	0/1	1	1	654
2N2060		NM	0.5 A	1000	0	0.5	30	100 u	60	15	0.9	5.0	9,35 A	8.0	1000 H	78	654
2N2223		NM	0.5 A		0	0.5	25	100 u	50	8 015	0.8	15	1.2	10	50 m	78	654
2N2223A	W-08	NM	0.5 A	60	0	0.5	25	100 u	50	9 15	0.9	5.0	1.2	10	50 m	78	654
2N2453		NM	0.5 A	30	0	0.05	80	10 u	60	8.0	0.9	3.0	A 85.6	7.0	1000 H	78	654
2N2453A		NM	0.5 A	50	0	0.05	80	10 u	60	8.0	0.9	3.0	A 88.0	4.0	1000 H	78	654
2N2480A		NM	0.3 A	40	0	0.5	50	1.0 m	50	18	0.8	5.0	1.3	10	50 m	7,8	654
2N2639 2N2640		NM	0.3 A	45 45	0	0.03	50	10 u	80	8.0	0.9	5.0	A 272	4.0	AUD	78 78	654 654
2N2641		NM NE	0.3 A 0.3 A	45	0	0.03	50	10 u	80	8.0	0.8	10	0,35 A	4.0	AUD	78	654
		-					-			-	0.0					-	
2N2642 2N2643		NM NM	0.3 A 0.3 A	45	0	0.03	100	10 u	80	8.0	0.9	5.0	675 A 0.35 A	4.0	AUD	78 78	654 654
2N2644		NE	0.3 A	45	0	0.03	100	10 u	80	8.0	0.0	10	W 00'''	4.0	AUD	78	654
2N2652		NM	0.3 A	60	0	0.05	50	1.0 m	60	9 15	0.85	3.0	1.2	10	50 m	78	654
2N2652A		NM	0.3 A	60	0	0.5	50	1.0 m	60	15	0.9	3.0	A 28.0	8.0	1000 H	78	654
2N2721		NM	0.3 A	60	0	0.04	30	0.1 m	80	6.0	0.8	10	1.0	10	10 m	78	654
2N2722	70 m	NM	0.3 A	45	0	0.04	50	1.0 u	100	6.0	0.9	5.0	1.0	20	10 m	78	654
2N2903		NM	0.6 C	30	0	0.05	125	1.0 m	60	8.0	0.8	10	575 A	7.0	1000 H	78	654
2N2903A		NM	0.6 C	30	0	0.05	125	1.0 m	60	8.0	0.9	5.0	A 8.0	7.0	1000 H	78	654
2N2913		NE	0.3 A	45	0	0.03	60	10 u	60	6.0	0	13-	0.8 A	4.0	AUD		654
2N2914		NE	0.3 A	45	0	0.03	150	10 u	60	6.0	10	16	135 A	3.0	AUD		654
2N2915	A 0.1	NM	0.3 A	45	0	0.03	60	10 u	60	6.0	0.9	5.0	8.6 A	4.0	AUD		654
2N2916		NM	0.3 A	45	0	0.03	150	10 u	60	6.0	0.9	5.0	A 88.0	3.0	AUD		654
2N2917		NM	0.3 A	45	0	0.03	60	10 u	60	6.0	0.8	10	0.3 A	4.0	AUD		654
2N2918		NM	0.3 A	45	0	0.03	150	10 u	60	6.0	0.8	10	A-8.0	3.0	AUD		654
2N2919		NM	0.3 A	60	0	0.03	60	10 u	60	6.0	0.9	5.0	A 6.0	4.0	AUD		654
2N2920		NM	0.3 A	60		0.03	150	10 u	60	6.0	0.9	5.0	A ava.	3.0	AUD		654
2N3043	1111	NM	0.25 A	45	0	0.03	100	10 u	30	8.0	0.9	5.0	w cert	5.0	AUD		610/
2N3044		NM	0.25 A	45	0	0.03	100	10 u	30	8.0	0.8	10	y szst	5.0	AUD		610/
2N3045		NE NE	0.25 A 0.25 A	45 45	0	0.03	100	10 u	30	8.0	0	-	A 88.0	5.0	AUD	- 1	610/
2N3048 2N3726		PE	0.25 A 0.4 A	45	0	0.03	135	1.0 m	200	8.0	0.9	5.0	A 878. A 8.0	5.0	AUD 1000 H		610/
2N3727		PE	0.4 A	45	0	0.3	135	1.0 m	200	8.0	0.9	2.5	A BES	4.0	1000 H		654
2N3806		PE	0.4 A	60	0	0.05	150	0.1 m	100	4.0	0.5	6	EZE VI	7.0	1000 H		654
2N3807	m 08	PE	0.5 A	60	0	0.05	300	0.1 m	100	4.0	10	0	A 8:0	4.0	100 H		654
2N3808		PM	0.5 A	60	0	0.05	150	0.1 m	100	4.0	0.8	5.0	A 26.0	7.0	100 H		654
2N3809		PM	0.5 A	60	0	0.05	300	0.1 m	100	4.0	0.8	5.0	A SEE	4.0	100 H		654
2N3810		PM	0.5 A	60	0	0.05	150	0.1 m	100	4.0	0.9	3.0	8 8T8	7.0	100 H		654
2N3810A		PM	0.5 A	60	0	0.05	150	0.1 m	100	4.0		1.5	A 878	3.0	100 H		654
2N3811		PM	0.5 A	60	0	0.05	300	0.1 m	100	4.0		3.0	A 22 0	4.0	100 H		654

Some columns show 2 different types of data indicated by either bold or italic typefaces. See key and headings.

TABLE 2. Bipolar Transistors — Duals (continued)

TYPE N	O. 100 ¹	ID	PD Watts One Oie	V _{CE} -Volts	Subscript	IC Amp Max	hFE®	Dirt.	f _T MHz Min	C _{ob} pF Max	hFE1 hFE2 ton ns Max	Max toff ns Max	dB Min VCE (sat) (e Volts	NF @ dB Max Typ* IC @ &	MOS (PAC TO-	CKAGE Case
	bit.		Only	Re		V			Typ*	Typ*	Typ*	Typ*	Max	n		No.	No.
2N3811A		PM	0.5 A	60	0	0.05	300	0.1 m	100	4.0	0.95	1.5		1.5	100 H	SOLAS	654
2N3813		PA	0.5 A	60	0	0.05	300	0.1 m	100	4.0		0.1		2.5	AUD	9	610A
2N3816A		PM	0.5 A	60	0	0.05	150	0.1 m	100	4.0	0.95	(5.10.00)	-	7.0	100 H	-	610A
2N3817		PM	0.5 A	60	0	0.05	300	0.1 m	100	4.0	0.9	3.0		4.0	100 H		610A
2N3838		CE	0.25 A	40	0	0.6	100	150 m	200	8.0	50	340		8.0	1000 H	9.9	610A
2N4015	- 01	PM	0.4 A	60	0	0.3	135	1.0 m	200	8.0	0.9	5.0		4.0	1000 H	90	654
2N4016		PM	0.4 A	60	0	0.3	135	1.0 m	200	8.0	0.9	2.5		4.0	1000 H		654
2N4854		CE	0.3 A	40	0	0.6	100	150 m	200	8.0	60	350		8.0	1000 H		654
2N4855		CE	0.3 A	40	0	0.6	40	150 m	200	8.0	60	350	11111	8.0	1000 H	90	654
2N4937		PM	0.6 A	40	.0	0.05	50	1.0 m	300	5.0	0.9	3.0		4.0	AUD	93	654
2N4938		PM	0.6 A	40	0	0.05	50	1.0 m	300	5.0	0.8	5.0	-	4.0	AUD		654
2N4939		PE	0.6 A	40	0	0.05	50	1.0 m	300	5.0		2.0		40	AUD		654
2N4941	15	PM	0.6 A	40	0	0.05	50	1.0 m	300	5.0	0.9	3.0		4.0	AUD	90	610A
2N5793		NG	0.5 A	40	0	0.6	40	150 m	200	8.0	45	310	0.3	10	150 m	575	654
2N5794		NG	0.5 A	40	0	0.6	100	150 m	200	8.0	45	310	0.3	10	150 m		654
2N5795		NG	0.5 A	60	0	0.6	40	150 m	200	8.0	47	140	0.4	10	150 m		654
2N5796		NG	0.5 A	60	0	0.6	100	150 m	200	8.0	47	140	0.4	10	150 m	1381/	654
2N6502		NS	0.6 A	40	0	1.0	50	100 m	250	10	35	60	0.3	10	100 m		654

Vgs = 5.0 V orbos | 5.0 V pF |

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

| Part | **Surface Mount Multiples**

TABLE 3. Quad Transistors

			h	FE			
Device	V(BR)CEO	V(BR)CBO	Min	@ Ic	f _T Min	@ mA	Package
MMPQ2222	40	60	30	300	350*	20	SO-16
MMPQ2222A	40	75	40	500	350*	20	SO-16
MMPQ2907	40	40	30	300	350*	50	SO-16
MMPQ2907A	of be 150 50 5 veri	60	50	500	350*	50	SO-16
MMPQ3467	40	40	20	500	125	50	SO-16
MMPQ3725	40	60	25	500	250	50	SO-16
MMPQ3725A	50	70	30	500	200	50	SO-16
MMPQ3762	40	40	20	1000	150	50	SO-16

*Тур

FETs

TABLE 4. TMOS FETs — Quads

N-CHANNEL TMOS QUAD — CASE 646-06 (14-PIN DIP)

PACKAGE TO- Case No. No.	§ 31	rDS	(on) @	VG	S(th) V	V _(BR) DSS	C _{iss}	C _{rss}	t _{on}	t _{off}
Device	14 001	Max	a A	Min	Max	Min	Max	Max	Max	Max
MFQ930P	GUA	1.4	1.0	1.0	3.5	35	70	18	15	15
MFQ960P	H 083	1.7	1.0	1.0	3.5	60	70	a.0 18	15	15
MFQ6659P	H 0001	1.8	1.0	0.8	2.0	36	50	10	5.0	5.0
MFQ1000P	H QUUI	2.0	0.5	0.0	10	35	0 00	C P.U	10	10
MFQ990P	55 00001 55 00001	2.0	1.0	1.0	3.5	90	70	18	15	15
MFQ6660P	H-0001	3.0	01.0	0.8	2.0	35	50	6010 B	5.0	5.0
MFQ6661P	AUD	4.0	1.0	0.8	2.4	90	50	16	5.0	5.0
MFQ170P	OUA	5.0	0.2	0.8	3.0	8 60	0 6	Kao- 3	10	10
MFQ9200P	OUA	6.2	0.2	1.0	4.0	200	90	3.5	15	15
MFQ107AP	160 m	6.4	0.25	01.0	3.0	200	90	3.5	1 -	362514
MFQ107P	100.003	14	0.2	1.0	3.0	200	90	3.5	<u> </u>	348 73t

	rDS(on)		V(BR)DSS Volt	ID(on) VGS = 10 V	G	fs @	Ciss @ 25 V	Coss @ 25 V	C _{rss} @ 25 V	td(on)	tr	^t d(off)	tf on emi
Device	Ω Max	mA	Min	V _{DS} = 5.0 V Amp	mhos Min	5.0 V Amp	pF Max	pF Max	pF Max	ns Max	ns Max	ns Max	ns Max
IRFE110	0.6	800	100	1.0	0.8	0.8	200	100	25	20	25	25	20
IRFE113	0.8	800	60	0.8	0.8	0.8	200	100	25	20	25	- 25	20

P-CHANNEL TMOS QUAD — CASE 648-06 (16-PIN DIP)

				(.		,							
IRFE9120	0.8	800	100	1.0	0.8	0.8	450	350	100	50	100	100	100
IRFE9123	0.6	800	60	0.8	0.8	0.8	450	350	100	50	100	100	100

Diode Array and Dual Diodes

Multiple diode configurations utilize monolithic structures fabricated by the planar process. They are designed to satisfy fast switching requirements as in core driver and encoding/decoding applications where their monolithic configurations offer lower cost, higher reliability and space savings. The MMAD Series in surface mount packages maximize board packing density.

TABLE 5. Diode Arrays

		Pin Co	nnections
Device	Function	Package	Diagram No.
MAD130C MAD130P	Dual 10 Diode Array Dual 10 Diode Array	632-02 646-06	1
MMAD130	Dual 10 Diode Array	751A-02	2
MAD1103C	16 Diode Array	632-02	3
MAD1103F	16 Diode Array	606-04	4
MAD1103P	16 Diode Array	646-06	3
MMAD1103	16 Diode Array	751A-02	3
MAD1104C	Dual 8 Diode Array	632-02	5
MAD1104F	Dual 8 Diode Array	607-04	5
MAD1104P	Dual 8 Diode Array	646-06	5
MMAD1104	Dual 8 Diode Array	751A-02	5
MAD1105C	8 Diode Common Cathode Array	632-02	6
MAD1105F	8 Diode Common Cathode Array	606-04	7
MAD1105P	8 Diode Common Cathode Array	646-06	6
MMAD1105	8 Diode Common Cathode Array	751A-02	6

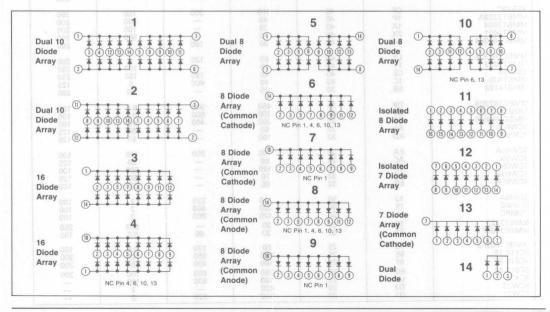
TABLE 5. Diode Arrays (continued)

			Pin Con	nections
Device 38A3	Function		Package	Diagram No.
MAD1106C AA865-OT MAD1106F MAD1106P MAD1106	B Diode Common Anode Array B Diode Common Anode Array B Diode Common Anode Array B Diode Common Anode Array	Es a galsier to traisi	632-02 606-04 646-06 751A-02	9 8 8 8
MAD1107C MAD1107F MAD1107P MMAD1107	Dual 8 Diode Array	nsistors	632-02 607-04 646-06 751A-02	10 10 10 10
MAD1108C MAD1108F MAD1108P MMAD1108	8 Isolated Diode Array 8 Isolated Diode Array 8 Isolated Diode Array 8 Isolated Diode Array	2102000001	620-02 650-02 648-06 751B-03	11 11 ,aas3-111:uom3
MAD1109C MAD1109F MAD1109P MMAD1109	7 Isolated Diode Array 7 Isolated Diode Array 7 Isolated Diode Array 7 Isolated Diode Array		632-02 607-04 646-06 751A-02	12 12 12 12
MMAD1185	7 Diode Common Cathode Array	88	751-02	13

TABLE 6. Dual Diodes

Device 001	Diagram No.	V _(BR) Volts @ Min	I(BR) A	I _R A Max	a V _R	VF Volts @ Min/Max	IF mA	C @V _R =0 pF (Max)	t _{rr} ns Max	Package
MSD6100	14	100	100	0.1	50	0.67/0.82	10	1.5	4.0	TO-226AA
MSD6101	14	50	100	0.1	40	0.67/0.82	10	2.0	10	1 -CWP 2
MSD6102	14	70	100	0.1	50	0.67/1.0	10	3.0	100	HUYAGS .
MSD6150	14	70	100	0.1	50	-/1.0	10	8.0	100	0.90008

Diode Array Diagrams



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Surface Mount Devices

A wide variety of discrete components from Motorola's repertoire of reliability-proven semiconductor processes and geometries are available in the SOT-23 packages. Products include Bipolar and Field-Effect Transistors, Switching, Zener and Varactor Diodes. This package is capable of holding a 25 mil x 25 mil maximum die size.

CASE 318 TO-236AA TO-236AB

SOT-23 Bipolar Transistors

TABLE 1. General-Purpose Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending breakdown voltage.

\$1			\$8-55	18				hFE	id helphal V	fT 300 rtd
Device			N	larking	V(BR)CEO	Min		Max	@ Ic (mA)	Min (MHz)
NPN S										
BC846A BC846B BSS82B BC817-16 BC817-25			\$0-13	1A 1B CH 6A 6B	65 65 60 45 45	110 200 40 100 160	(STO)	220 450 120 250 400	2 2 150 100 100	100 100 100 200 200
BC817-40 BC847A BC847B BC847C BCX70K		0 = p (Mak)	(Vi)) (Vi))	6C 1E 1F 1G AK	45 45 45 45 45	250 110 200 420 100	FIB)	600 220 450 800	100 2 2 2 2 50	200 100 100 100 100 125
BCX70J BCW72 BCX70H BCX70G MMBT93	4,0 10 100 100		8 8	AJ K2 AH AG 1X	45 45 45 45 45 45	90 200 70 60 150	001	450 220	50 2 50 50 0.5	125 grad 125 125 125 30
BCW71 BCX19 MMBC16 MMBC16 MMBC16	23L6			K1 U1 L7 L6 L5	45 45 40 40 40	110 40 300 200 135	201	220 ———————————————————————————————————	2 500 1 1 1	200 200 200 200 200
BSS79C MMBT22 MMBT39 MMBT44 MMBC16	04 01		-0	CF 1P 1A 2X L4	40 40 40 40 40 40	30	Ingel	100	150 500 100 500	250 200 200 250 250 200
MMBC16 MMBT39 BSS79B MMBTA2 MMBT41	03	DM (D)		L3 1Y CE 1C 5B	40 40 40 40 30		Side Servi	120 120 400	1 100 150 5 50	200 250 250 125 250
MMBC16 MMBC16 MMBC16 BCW60A BCW60D	22D7			D8 D7 D6 AA AD	35 35 35 32 32		EES/	900 600	0.5 0.5 0.5 50 50	100 100 100 125 125
BCW65A BCW60C BCW65C BCW60B BCW65B				EA AC EC AB EB	32 32 32 32 32 32 32	100 90 100 70 60	istas Com	1 <u>=</u> .	100 50 500 500 50	100 125 100 125 100
BC848A BC848B BC848C MMBT22 MMBC10			·0	1J 1K 1L 1B F1	30 30 30 30 25	200 420	Sio versi Com	450 800	2 2 2 500 0.5	100 100 100 250 150
MMBC10 BC818-16 BC818-25 BC818-40 BCX20 BCW33 BCW31	1			F3 6E 6F 6G U2 D3 D1	25 25 25 25 25 25 20 20	250	eray	400 600	0.5 100 100 100 100 2 2	150 200 200 200 200

TABLE 1. General-Purpose Transistors (continued)

			THE RESERVE		hFE		fT
Device		Marking	V(BR)CEO	Min	Max	@ I _C (mA)	Min (MHz)
NP			DITTOLO		.Ti gnii	medado To reidio n	Design ere soon
-		200	1 00	(and sent)	politaling	100	450
MMBT8599 BC856A BC856B MMBT8598	(Auto) Of	2W 3A 3B 2K	80 65 65 60	75 125 220 75	250 475	100	150 100 100 150
BSS82C		CM	60	100	300	150	100
MMBT2907A MMBA811C8 BC807-16 BC807-25 BC807-40		2F C8 5A 5B 5C	60 45 45 45 45	50 450 100 160 250	900 250 400 600	500 5 100 100 100	200 50 200 200 200
BC857A		3E	45	125	250	AT 2	100
BC857B		3F	45	220	475	2 2	100
BC857C BCX71K MMBA811C7		3G BK C7	45 45 45	420 100 300	800 600	48 50 MA 5	100 — 50
BCX71J BCW70 MMBA811C6 BCW68G MMBA811C5		BJ H2 C6 DG C5	45 45 45 45 45 45	100 215 200 60 135	500 400 — 270	50 2 5 500 5	50 100 50
BCW69 BCX71G BCW68F BCX17 MMBA813S4		H1 BG DF T1 S4	45 45 45 45 45	120 60 35 100 100	260 — 600 200	2 50 500 100 50	100 100 100
MMBA813S3 MMBA813S2 MMBA812M7 MMBA812M6 MMBA812M5		S3 S2 M7 M6 M5	45 45 40 40 40	75 50 300 200 135	150 100 600 400 270	50	100 100 150 150 150
MMBT2907		2B	40	30	gris	500	200
MMBT3906 MMBT4403 MMBA812M4 MMBA812M3		2A 2T M4 M3	40 40 40 40	100 100 90 60	300 300 180 120	10 150	250 200 150 150
BSS80B BSS80C MMBTA70 BCW61D BCW61C		CH CJ 2C BD BC	40 40 40 32 32	40 100 40 110 100	120 30 400 —	5 50 50	200 200 125
BCW67C		EC	32	100	- 5		100
BCW61B		BB	32	80	-	50	100
BCW67B BCW61A		DB BA	32 32	60 60		500 50	100
BCW67A		0 DA	32	35	- 0	500	100 TSM
BC808-16 BC808-25 BC808-40 BC858A BC858B		5E 5F 5G 3J 3K	25 25 25 30 30	100 160 250 125 220	250 400 600 250 475	100 100 100 2 2	200 200 200 100 100
BC858C MMBT4125 BCX18		3L ZD T2	30 30 25	420 25 40	800		100 200
MMBTA55		AL	25	30	_	500	100
BCW30 BCW29		C2 C1	20	215 120	500 260	2 2	I I

TABLE 2. Switching Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending fr.

		Switching	Time (ns)	V(BR)CEO		hFE		on firms
Device	Marking	ton	toff		Min	Max	@ I _C (mA)	Min (MHz)
NPN SEE								
MMBT2369	1J	12	18	15	20	MAD	100	280
BSV52	B2	12	18	12	40	120	10	400
MMBT2222	1B	35	385	30	30	753	500	250
MMBT2222A	1P	35	385	40	40	700	500	200
MMBT4401	2X	35	255	40	40	100	500	250
MMBT3903	001 1Y	70	225	40	15	21.2	100	250
MMBT3904	1A	70	250	40	30	70	100	200
NP 001								2 V 28
MMBT3638A	BN	75	170	25	20	-	300	+ CX
MMBT3638	AM	00075	170	25	20	=======================================	300	VBA-CC2
MMBT3640	2J	25	35	12	20	_	50	500
MMBT4403	2T	35	225	40	90	180	1	150
MMBT2907	2B	45	100	40	30	142	500	200
MMBT2907A	2F	45	100	60	50	30	500	200
MMBT3906	2A	70	300	40	100	300	10	250

TABLE 3. VHF/UHF Amplifiers, Mixers, Oscillators

Pinout: 1-Base, 2-Emitter, 3-Collector

Fillout. I-Dase, 2-E	mitter, 3-Conector				
150	270	185	Cob	aw f	MMBARIZMS L
Device	Marking	V(BR)CEO	Max (pF)	Min (GHz)	@ I _C (mA)
NPN 085					
MMBT3960A MMBT3960 MMBTH10 MMBC1321Q3 MMBC1321Q4 MMBC1321Q5 MMBT318 MMBT918 MMBTH24	1T 15 3E Q3 Q4 Q5 3B 3B 3A	8 3 25 25 25 25 15 30	2 2 0.7 1.8 1.8 1.7	1.6 1.6 0.65 0.6 0.6 0.6 0.6	30 30 4 2 2 2 4 8
PNP 001					H 19WO
MMBTH81	3D	20	0.85	0.6	5 A 8WO

TABLE 4. Choppers

Pinout: 1-Base, 2-Emitter, 3-Collector

901	2	68	V(BR)CEO	hFE S			
Device	Marking	V(BR)EBO		Min	Max	@ Ic (mA)	
NP							
MMBT404	2M	12	24	30	400	12	

TABLE 5. Darlingtons

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending hpe.

Device Marking V(BR)CEO Max (V) Min Min	x @ Ic (mA)
MMBTA14 1N 30 1.5 20K -	
MMBTA13	100
PNP	
MMBTA64 2V 30 1.5 20K — MMBTA63 2U 30 1.5 10K —	100 E 32 E 100 T 864

TABLE 6. Low-Noise Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of ascending NF.

		NF			hFE	months in author of	named fr
Device	Marking	Typ (dB)	V(BR)CEO	Min	Max	@ Ic (mA)	Min (MHz)
IPN	Tues (dR) (m) to (m)	DUI - WY TEAM	ed in 19th out	BO was I	Sant of the		
MMBT5088	10	1	30	300		10	50
MMBT5089	1R	1	30	400	_	10	50
MMBT2484	1U	3	60	n=	800	8 10 XV 8 10 SV 10 SV	15
MMBT6428	1K	3	50	250	or -	10 00	100
MMBT6429	0 1L 1	3	45	500	98 -	a 10 of	100
NP		er	3 3	10	16	8 19	264
MMBT5086	2P	1	50	150	_	10	40
MMBT5087	20	1 1 a	50	250	1 -	2 2 3	40
BC849B	2B	4*	30	200	450	85 2 BT	100
BC849C	2C	a 4*	30	420	800	2	100
BC850B	2F	4*	45	200	450	2 a 2 ac	100
BC850C	2G	8 4*	45	420	800	1 2 AC	100
BC859A	4A	4*	30	100	220	2	100
BC859B	4B	4*	30	200	450	2 4	100
BC859C	4C	4*	30	420	800	2 5	100
BC860A	4E 💎	a 4*	45	100	220	\$ 2 00	100
BC860B	4Fast	a 4* a	45	200	450	2 2	100
BC860C	4G	2 4*	45	420	800	2	100

TABLE 7. High-Voltage Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices are listed in order of descending breakdown voltage.

				hFE		fT	
Device	Marking	V(BR)CEO	Min	Max	@ Ic (mA)	Min (MHz	
NPN							
MMBT6517 MMBTA42 MMBTA43 MMBC1654N5 MMBC1654N6 MMBC1654N7 MMBT5550 MMBT5551	1Z 1D 1E N5 N6 N7 1F G1	350 300 200 160 160 160 160	15 40 40 50 100 150 30 30	130 220 330	100 30 30 15 15 15 50	40 50 50 120 120 120 100	
PNP							
MMBT6520 MMBTA92 MMBTA93 MMBT5401	2Z 2D 2E 2L	350 300 200 150	15 25 25 50		100 30 30 50	40 50 50 100	

TABLE 8. Drivers

Pinout: 1-Base, 2-Emitter, 3-Collector

	spd.		Anna M	fr			
Device	Marking	V(BR)CEO	Min	Max	@ I _C (mA)	Min (MHz)	
NPN							
MMBTA06 BSS64 MMBTA05	1G AM 1H	80 80 60	50 20 50	80	100 4 100	100 50 100	
PNP						역상	
BSS63 MMBTA55 MMBTA56	BM 2H 2G	100 60 80	30 50 50	98 =	25 100 100	50 50 50	

TABLE 9. RF Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Devices	are	listed	in	order	of	descending	fr.

	75011	7	fT		ORNIBE	NF		877104.00	MAG		f
Device	Marking	Typ (GHz)	I _C (mA)	V _{CE} (V)	Typ (dB)	@ I _C (mA)	VCE (V)	Typ (dB)	@ I _C (mA)	VCE (V)	(MHz
NPN		01		1906							
MMBR571	7X	8	50	10	2	5	6	16.5*	5	6	500
MMBR911	7P	6	30	10	2	10	10	17*	10	5 85	500
MMBR930	7C	5.5	30	5	1.9	2	£ 5	11	30	5	500
BFR92	P1	3	14	10	3	3	1.5	_	_	_	500
BFR93	R1	3	30	5	2.5	2	5				30
	1 1 1		-	031	60		TV-L	28		188	WETTER
MMBR931	7D	3.5	1	0201	4.3	0.5	1 1	10 05	1	1 18	1000
MMBR2060	7E	2.5	20	001	2	1.5	10	13 85	20	10	450
MMBR5179	7H	1.5	5	6	4 08	1.5	6	11 08	5	6	450
MMBR920	7B	4.5	14	10	2.4	2	10	15	2	10	500
MMBR901	7A	4	15	10	1.9	5	6	16	5	6	1000
MMBR941	7Y	8	15	6	1.7	5	6	12.5	5	6	2000
MMBR951	7Z	7.5	30	6	1.7	5	6	12.5	5	6	2000
MMBR5031	7G	2	055 5	6	1.9	1	6	17	1	6	450
MMBR2857	7K	1.2	4	10	3	1.5	6	12.5	1.5	6	450
BFS17	E1	1	2	5	5	2	5	- 01	1.2	_	30
NP							хвил		ALL OF		
MMBR536	7R	5.5	20	5	4.5	10	5			<u> </u>	500
MMBR4957	7F	2	2	10	3	2	10	17	2	10	450

SOT-23 Field Effect Transistors (JFETs)

TABLE 10. RF JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

Market on the same of the same of		NF					
Device	Marking	Typ (dB)	f (MHz)	Min (mmhos)	Max (mmhos)	V _{DS} (V)	V(BR)GSS
N-CHANNEL							
MMBFU310	6C	1.5	1	10	18	10	- 25
MMBF102	531875	3**	_	2	7.5	15	- 25
MMBF108*		3**	100	2	7.5	15	-25
MMBF112	TV	3**	_	1	7.5	10	- 25
MMBF5484	6B	2	100	3	6 9201	15 15	- 25
MMBF5485*		2	100	3.5	7	15	- 25
MMBF5486	6H	2	100	4	8	15	- 25
MMBF4416	6A	2	100	4.5	7.5	15	-30
MMBFJ310	6T	4	450	8	18	10	-25

**Max

TABLE 11. General-Purpose FETs

Pinout: 1-Drain, 2-Source, 3-Gate

15 18		1.1		Yfs	07	OV ID:	SS
Device	Marking	V(BR)GSS	Min (mmhos)	Max (mmhos)	V _{DS} (V)	Min (mA)	Max (mA)
N-CHANNEL						AVX 70	POTVA
MMBF5457 MMBF5459	6D 6L	25 25 25	1 2	5 6 6	15 15	0 1 XTA 4 XVA	5 16
P-CHANNEL				0.0			
MMBF5460	6E	07 -40	1	06 4 1.0	-15	đE 1 XEA	5

TABLE 12. Chopper/Switches, JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

		rDS(on)	toff		VGS	(off)	ID	SS
Device	Marking	Max (Ohms)	Max (ns)	V(BR)GSS	Min (V)	Max (V)	Min (mA)	Max (mA
N-CHANNEL						deserted b		
MMBF4391	6J	30	20	30	-4	-10	50	150
BSR56	M4	25	25	40	s0 1−4 bm	-10	50	s seb o id
MMBF4860	6F	40	50	30	-2	-6	20	100
BSR57	M5	40	50	40	-2	-6	20	100
MMBF4392	6K	60	35	30	-2	-5	25	75
BSR58	M6	60	100	40	-0.8	-4	8	80
MMBF4393	6G	100	50	30	-0.5	-3	5	30
-CHANNEL								
MMBFJ175	6W	125	30(t)	-30	3	6	-7	-60
MMBFJ177	6Y	300	45(t)	-30	0.8	2.5	-1.5	-20

TABLE 13. TMOS FETs

Pinout: 1-Gate, 2-Source, 3-Drain

		rDS(on)		08	VGS	S(th)	Switching Time	
Device	Marking	Ohm	mA	VDSS	Min (V)	Max (V)	ton ns	t _{off} ns
LCHARINE								
N-CHANNEL								
MMBF170	6Z	015	200	60	0.8	3	10	10
	6Z SA	015	200 100	60 100	0.8	3 2.8	10 20	10 40

SOT-23 Switching Diodes Santial Service Solution (1997) Service Solution (1997) Solution (1997

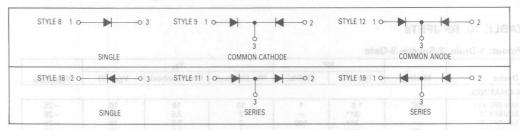


TABLE 14. General-Purpose Diodes

- 25 - 30		ar at V	(BR)R	1	R	907 007	VF	2 2	CT	t _{rr}	Pin Out
Device	Marking	Min (V)	@ I _{BR} (μA)	Max (μA)	@ V _R (V)	Min (V)	Max (V)	@ IF (mA)	Max (pF)	Max (ns)	Case
SINGLES											
MMBD6050X	5AX	70	100	0.1	50	0.85	1.1	100	2.5	15	8
MMBD914X	5DX	100	100	5	75		1	10	4	15	8
MBAS16	A6X	75	100	1	75		1.3	100	2	15	8
MBAL99	TFX	70	10	2.5	70		1.1	50	1.5	15	18
DUALS	f (Am)	Mia	(V) agV	{aprimm	e) Max	orlean) ai	M RB	otre)V	Marking		soh
MBAV70	A4X	70	100	5	70		1.1	50	1.5	15	9
MBAW56	A1X	70	100	2.5	70	1	1.1	50	1.5	15	12
MBAV99	A7X	70	100	2.5	70	2	1.1	50	1.5	15 8	111
MBAV74	JAX	50	5	0.1	50		1	100	2	Ja	9
MMBD2835X	A3X	35	100	0.1	30	1	1	10	4	15 0	12
MMBD2836X	A2X	75	100	0.1	50		1	10	4	15	12
MMBD2837X	A5X	35	100	0.1	30		1	10	4	15	9
MMBD2838X	A6X	75	100	0.1	50			10	4	15	9
MMBD6100	5B	70	100	0.1	50	0.85	1.1	100	2.5	15	9
MMBD7000	5C	100	100	0.3	50	0.75	1.1	100	1.5	15	11

TABLE 15. Mixer and Detector Diodes

Pin Diodes are designed for VHF Band and General Purpose Switching. Hot Carrier Diodes are ideal for VHF, UHF applications.

30	8	V	(BR)R	c	T GE	Rs		VF	98	R	Pin Out
Device	Marking	Min (V)	@ I _R (μA)	Max (pF)	@ V _R (V)	Max (ohms)	Max (V)	@ IF (mA)	Max (μA)	@ V _R (V)	Case Style
PIN DIODES	(SINGLES)	2.5	8.0	08 -	(1)88		300	Y3		VT CHB
MMBV3700 MMBV3401	4R 4D	200 35	10 10	1	20 20	1 0.7			0.1 0.1	150 25	8
HOT CARRIE	R SCHOT	TKY DIOI	DES (SINGL	ES)			Age dear		aTBR at	THE	Hill
MMBD101 MMBD201 MMBD301 MMBD501 MMBD701	4M 4S 4T 5F 5H	4 20 30 50 70	10 10 10 10 10	1 1.5 1.5 1	0 15 15 20 20	Air	0.6 0.6 0.6 1.2 1.2	10 10 10 10	0.25 0.2 0.2 0.2 0.2	3 15 25 25 25 35	8 8 8 8
HOT CARRIE	R SCHOT	TKY DIOI	DES (DUAL	S)						13	MAINN
MMBD352 MMBD353	5G 4F	4 4	10 10	10 1	0	905	0.60 0.6	a 10 a 10	0.25 0.25	3 3	11 19
95	0.5		2.3		U8	000	3	- 63	202		100

TABLE 16. Zener Diodes

Zener Diodes are offered in two popular series. The MMBZ5226 has the same specifications as the standard axial leaded 1N5226 series. The BCX84 series is identical to popular European series SOT-23's.

Pinout: 1-Anode, 2-NC, 3-Cathode (V_F = 0.9 V Max @ I_F = 10 mA for all types.)

Device	Marking	Test Current IZT mA	Zener Voltage VZ (±5%) Nominal	Z _{ZK} I _Z = 0.25 mA Ω Max	Z _{ZT} I _Z = I _{ZT} @ 10% Mod Ω Max	Max IR @ µA	v _R
MMBZ5226B	8A	20	3.3	1600	28	25	1.0
MMBZ5227B	8B	20	3.6	1700	24	15	1.0
MMBZ5228B	8C	20	3.9	1900	23	8.8 10 45	1.0
MMBZ5229B	8D	20	4.3	2000	22	5.0	1.0
MMBZ5230B	8E	20	4.7	1900	19	5.0 85	2.0
MMBZ5231B	8F	20	5.1	1600	8 417 3.8	5.0 85	2.0
MMBZ5232B	8G	20	5.6	1600	11	5.0	3.0
MMBZ5233B	8H	20	6.0	1600	7.0	5.0	3.5
MMBZ5234B	8J	20	6.2	1000	7.0	5.0	4.0
MMBZ5235B	8K	20	6.8	750	5.0	4.11 3.0 SY	5.0
MMBZ5236B	8L	20	7.5	500	6.0 8.81	8 8 3.0 AV	6.0
MMBZ5237B	M8	20	8.2	500	8.0	3.0	6.5
MMBZ5238B	8N	20	8.7	600	8.0	8.81 3.0 eV	6.5
MMBZ5239B	8P	20	9.1	600	10	8.87 3.0	7.0
MMBZ5240B	80	20	10	600	17	3.0	8.0
MMBZ5241B	8R	20	11 8	600	22 889	2.0	8.4
MMBZ5242B	85	20	12	600	30	1.0	9.1
MMBZ5243B	8T	9.5	13	600	13 8 8 8	0.5	9.9
MMBZ5244B	8U	9.0	14	600	8 15	0.1	10
MMBZ5245B	8V	8.5	15	600	16	18 0.1 SFY	11
MMBZ5246B	8W	7.8	16	600	17	0.1 Am S	12
MMBZ5247B	8X	7.4	17	600	19	0.1	13
MMBZ5248B	8Y	7.0	18	600	21	0.1	14
MMBZ5249B	8Z	6.6	19	600	23	0.1	14
MMBZ5250B	81A	6.2	20	600	25	0.1	15
MMBZ5251B	81B	815 895.6	22	600	29 29	H bnso.1undA .pec	17 8191
MMBZ5252B	81C	5.2	24	600	33	0.1	18
MMBZ5253B	81D	5.0	25	600	35	0.1	19
MMBZ5254B	81E	4.6	27	600	41	0.1	21
MMBZ5255B	81F	4.5	28	600	44	0.1	21
MMBZ5256B	81G	4.2	30	600	49	0.1	23
MMBZ5257B	81H	3.8	33	700	58	0.1	25

TABLE 16. Zener Diodes (continued)

Pinout: 1-Anode, 2-NC, 3-Cathode

bebsel leixe	bushnata	V	Z1 olts		Z2 olts		Z3 Its	goruă Goruă	I _Z mA	senes. el to pi	nalugog ow odnobi a Ma	x I _R (8X3)	Z _{ZT} (ohms) (max)
Device	Marking	Min	Max	Min	Max	Min	Max	IZ1	I _{Z2}	I _{Z3}	@ VR (Volts)	I _R (μA)	@ I _Z = I _{Z1}
BZX84C3V3	Z14	3.1	3.5	2.3	2.9	3.6	4.2	5	1	20	1	5	95
BZX84C4V3	W9	4	4.6	3.3	4	4.4	5.1	5	1	20	Inem; 2	3	90
BZX84C4V7	Z1	4.4	5	3.7	4.7	4.5	5.4	5	12	20	2	3	80
BZX84C5V1	Z2 A	4.8	5.4	4.2	5.3	5	5.9	5	min pid	20	2	2 3 4	60
BZX84C5V6	Z3	5.2	6	4.8	6	5.2	6.3	5	8.8	20	2	As	40
BZX84C6V2	Z4	5.8	6.6	5.6	6.6	5.8	6.8	5	3.6	20	4	3	10
BZX84C6V8	Z5	6.4	7.2	6.3	7.2	6.4	7.4	5	1	20	4	2	15
BZX84C7V5	Z6	7	7.9	6.9	7.9	7	8	5	1	20	5	3 2 1	15
BZX84C8V2	Z7	7.7	8.7	7.6	8.7	7.7	8	5	1	20	5	0.7	15
BZX84C9V1	Z8	8.5	9.6	8.4	9.6	8.5	9.7	5	1.2	20	6	0.5	15
BZX84C10	Z9	9.4	10.6	9.3	10.6	9.4	10.7	5	3.6	20	05	0.2	20
BZX84C11	Y1 0	10.4	11.6	10.2	11.6	10.4	11.8	5	0 1	20	8	0.1	20
BZX84C12	Y2	11.4	12.7	11.2	12.7	11.4	12.9	5	1	20	8	0.1	25
BZX84C13	Y3	12.4	14.1	12.3	14	12.5	14.2	5	1	20	8	0.1	30
BZX84C15	Y4 0	13.8	15.6	13.7	15.5	13.9	15.7	5	a.1	20	10.5	0.05	30
BZX84C16	Y5	15.3	17.1	15.2	17	15.4	17.2	5	8.2	20	11.2	0.05	40
BZX84C18	Y6	16.8	19.1	15.7	19	16.9	19.2	5	1	20	12.6	0.05	45
BZX84C20	Y7	18.8	21.2	18.7	21.1	18.9	21.4	5	1	20	14	0.05	55
BZX84C22	Y8	20.8	23.3	20.7	23.2	20.9	23.4	5	1	20	15.4	0.05	55
BZX84C24	Y9 0	22.8	25.6	22.7	25.5	22.9	25.7	5	111	20	16.8	0.05	70
BZX84C27	Y10	25.1	28.9	25	28.9	25.2	29.3	2	0.5	10	18.9	0.05	80(1)
BZX84C30	Y11	28	32	27.8	32	28.1	32.4	2	0.5	10	21	0.05	80(1)
BZX84C33	Y12	31	35	30.8	35	31.1	35.4	2	0.5	10	23.1	0.05	80(1)

NOTE: (1) rdiff (α Iz = 2 mA

TABLE 17. Tuning Diodes

General Purpose, Abrupt and Hyper-Abrupt Junction, Voltage Variable Capacitance diodes are used for tuning and control of RF circuits through UHF frequencies.

Pinout: 1-Anode, 2-NC, 3-Cathode

23 25		V _{(BR)R}		88	CT 008		Capacitance Ratio		o 3.8		D18	B+= 1	. Jaasas 81	
Device	Marking	Min (V)	@ I _R (μA)	Min (pF)	Max (pF)	@ V _R (V)	Min	Max	Тур	@ V _R (V)	& f (MHz)	Max (μA)	@ V _R	
TUNING DIOD	DES												1966 - 22	
MMBV105G	4E	30	10	1.8	2.8	25	4	6	350	3	50	0.05	28	
MMBV109	4A	30	10	26	32	3	5	6.5	250	3	50	0.02	25	
MMBV2101	4G	30	10	6.1	7.5	4	2.5	3.2	400	4	50	0.02	25	
MMBV2103	4H	30	10	9	11	4	2.5	3.2	350	4	50	0.02	25	
MMBV2108	4X	30	10	24.3	29.7	4	2.5	3.2	250	4	50	0.02	25	
MMBV2109	4J	30	10	29.7	36.3	4	2.5	3.2	200	4	50	0.02	25	
MMBV3102	4C	30	10	20	25	3	4.5	3.2	300	3	50	0.1	25	
MMBV409		20		26	32	3	1.5	1.9	300	3	50	_	_	
MMBV432L(1)	4B	14	10	43*	48.1*		1.5	2	100	2	50	0.1	9	

(1) Monolithic Dual, Style 9

*Each Diodes

TABLE 18. Thyristors

SILICON CONTROLLED RECTIFIERS

Device	Marking	(mA)	VFXM (mA)	lGT (μA)	VGT (V)	IH (mA)	Case Style
MMBS5060	erd no vae 5R Yerl e	500	25	200	0.8	5	14
MMBS5061	5S	500	50	200	0.8	5	14
MMBS5062	5T	500	100	200	0.8	5	14

SILICON PROGRAMMABLE UNIJUNCTION TRANSISTORS

NO VXTLXT		LIAL DORSHS	lp	IGAO	HOSSAS SSIS IV	MAL S	
Device	Marking	$R_G = 10 \text{ k}\Omega$ $\mu\text{A Min}$	$R_G = 1 M\Omega$ $\mu A Max$	@ 40 V nA Max	$R_G = 10 \text{ k}\Omega$ $\mu\text{A Min}$	$R_G = 1 M\Omega$ $\mu A Max$	Case Style
MMBPU131	5Z	MAL 88 5 342	2	VXTLXT5 MAL AS	70	50	14
MMBP6027 MMBP6028	5W 5V	5	0.15	10	70	50	20

JAN, JANTX, JANTXV, and JANS

Motorola offers over 650 devices listed in QPL-19500, and is certified to supply small-signal bipolar devices to ALL FOUR quality levels of MIL-S-19500.

The following tables list the Motorola discrete devices and slash-sheet number as they appear on the Qualified Products List.

TABLE 1. Switching and High-Frequency Transistors (MIL-S-19500)

2N702 IAN (152	ONIQUOE IAM ITY ITYY	SNISEOG IANI ITV ITVV
2N703 JAN	2N2905 JAN,JTX,JTXV /290	2N3506 JAN,JTX,JTXV /349
2N706 JAN	2N2905A JAN,JTX,JTXV /290	2N3507 JAN,JTX,JTXV /349
	2N2905AL JANS /	2N3634 JAN,JTX,JTXV /357
2N718A JAN,JTX,JTXV /181	2N2906 JAN,JTX,JTXV /291	2N3635 JAN,JTX,JTXV /357
2N869A JAN,JTX /283	2N2906A JAN,JTX,JTXV /291	2N3636 JAN,JTX,JTXV /357
2N914 JAN,JTX/373	2N2907 JAN,JTX,JTXV /291	2N3637 JAN,JTX,JTXV /357
2N916 JAN /271	2N2907A JAN,JTX,JTXV,JANS /291	2N3700 JAN,JTX,JTXV /391
2N918 JAN, JTX, JTXV, JANS /301	2N2944A JAN,JTX,JTXV /	2N3735 JAN,JTX,JTXV /395
2N930 JAN,JTX /253	2N2945A JAN,JTX,JTXV /	2N3737 JAN,JTX,JTXV /395
2N1132 JAN/177	2N2946A JAN,JTX,JTXV /	2N3743 JAN,JTX,JTXV /397
2N1613 JAN,JTX,JTXV /181	2N3013 JAN,JTX /287	2N3762 JAN,JTX,JTXV /396
2N2218 JAN,JTX,JTXV /251	2N3019,S JAN,JTX,JTSV /391	2N3763 JAN,JTX,JTXV /396
2N2218A JAN,JTX,JTXV /251	2N3250A JAN,JTX,JTXV /323	2N3764 JAN,JTX,JTXV /396
2N2219 JAN,JTX,JTXV /251	2N3251A JAN,JTX,JTXV /323	2N3765 JAN,JTX,JTXV /396
2N2219A JAN,JTX,JTXV /251	2N3253 JAN /347	2N4033 JAN,JTX,JTXV /511
2N22219AL JANS /	2N3444 JAN,JTX /347	2N4261 JAN,JTX,JTXV /511
2N2221 JAN,JTX,JTXV /255	2N3467 JAN,JTX,JTXV /348	2N4405 JAN,JTX,JTXV /488
2N2221A JAN,JTX,JTXV /255	2N3468 JAN,JTX,JTXV /348	2N4449 JAN,JTX,JTXV /317
2N2222 JAN,JTX,JTXV /255	2N3485A JAN,JTX /392	2N4453 JAN,JTX /283
2N2222A JAN,JTX,JTXV,JANS /225	2N3486A JAN,JTX /392	2N4930 JAN,JTX,JTXV /397
2N2369A JAN,JTX,JTXV,JANS/317	2N3498 JAN,JTX,JTXV /366	2N4931 JAN,JTX,JTXV /397
2N2481 JAN,JTX /268	2N3499 JAN,JTX,JTXV /366	2N5581 JAN,JTX /423
2N2904 JAN,JTX,JTXV /290	2N3500 JAN,JTX,JTXV /366	2N5582 JAN,JTX
2N2904A JAN,JTX,JTXV /	2N3501 JAN,JTX,JTXV /366	

TABLE 2. Multiple Devices (MIL-S-19500)

2N2919 JAN,JTX,JTXV /355 2N4854 JAN,JTX,JTXV /421 2N5795 JAN,JTX,JTXV 2N2920 JAN,JTX,JTXV /355 2N5793 JAN,JTX,JTXV /495 2N5796 JAN,JTX,JTXV 2N3810 JAN,JTX,JTXV /336	2N2919 JAN,JTX,JTXV /355 2N2920 JAN,JTX,JTXV /355	2N5793 JAN,JTX,JTXV /495	2N5795 JAN,JTX,JTXV /496
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TABLE 3. Field-Effect Transistors (MIL-S-19500)

2N2608 JAN /295	2N3823 JAN,JTX,JTXV /375	2N4860 JAN,JTX,JTXV /385
2N2609 JAN /296	2N4856 JAN,JTX,JTXV /385	2N4861 JAN,JTX,JTXV /385
2N3330 JAN,JTX /378	2N4857 JAN,JTX,JTXV /385	2N4091 JAN,JTX,JTXV /431
2N3821 JAN,JTX,JTXV /375	2N4858 JAN,JTX,JTXV /385	2N4092 JAN,JTX,JTXV /431
2N3822 JAN,JTX,JTXV /375	2N4859 JAN,JTX,JTXV /385	2N4093 JAN,JTX,JTXV /431

CECC

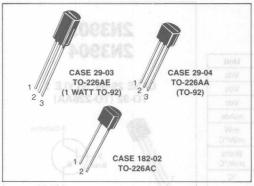
All CECC types are available to assessment levels E, F, L

TABLE 4. Qualified Types

2N2218A	2N2222	2N2484	2N2905A	2N2894	2N5415	
2N2218	2N2221A	2N2369A	2N2905	2N2907A	2N4033	PO7726
2N1893	2N2221	2N2369	2N2904A	2N2907	2N3501	CV9507
2N1711	2N2219A	2N2368	2N2904	2N2906A	2N3440	BC107-108-109
2N1613	2N2219	2N2222A	2N3019	2N2906	2N3439	2N5416

Qualified products to CECC 50,000

Plastic-Encapsulated



Motorola's plastic transistors and diodes encompass hundreds of devices spanning the gamut from general-purpose amplifiers and switches with a wide variety of characteristics to dedicated special-purpose devices for the most demanding applications. The popular high-volume TO-226AA (TO-92) package combines proven reliability, performance, economy and convenience to provide the perfect solution for industrial and consumer design problems.

As an additional service to our customers Motorola will, upon request, supply the following:

- Radial tape and reel
- Axial tape and reel
- TO-205AA (TO-5) lead forming
- TO-206AA (TO-18) lead forming

Contact your Motorola representative for ordering information.

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ng	8.58	
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n- on		
	s otherwise	
n.		

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltge	Vсво	60	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
*Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

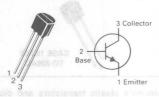
*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	-no°C/W

^{*}Indicates Data in addition to JEDEC Requirements.

2N3903 2N3904

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS			national ho	SET OTTO A	DAY OF FORE
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	noitemo	V(BR)CEO	State of the latest state	(81- CI I) AA	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)		V(BR)CBO	60	j	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	6.0	-	Vdc
Base Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc)		IBL	-	50	nAdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc)		ICEX	_	50	nAdc
ON CHARACTERISTICS					
DC Current Gain(1) (IC = 0.1 mAdc, $V_{CE} = 1.0 \text{ Vdc}$)	2N3903 2N3904	hFE	20 40	=	-
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N3903 2N3904		35 70	Ξ	
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N3903 2N3904		50 100	150 300	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N3903 2N3904		30 60	=	
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N3903 2N3904		15 30	_	
Collector-Emitter Saturation Voltage(1) (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)		VCE(sat)	Ξ	0.2 0.3	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{BE(sat)}	0.65	0.85 0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	2N3903 2N3904	fT	250 300	_	MHz

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	000	F 2. 32	Symbol	Min	Max	Unit
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	300		C _{obo}		4.0	pF **
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	3003		C _{ibo}		8.0	pF
Input Impedance (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)		2N3903 2N3904	h _{ie}	1.0 1.0	8.0 10	k ohms
Voltage Feedback Ratio (IC = 1.0 mAdc, VCE = 10 Vdc, f = 1.0 kHz)	- 05 E	2N3903 2N3904	h _{re}	0.1 0.5	5.0 8.0	X 10-4
Small-Signal Current Gain (IC = 1.0 mAdc, VCE = 10 Vdc, f = 1.0 kHz)	10	2N3903 2N3904	h _{fe}	50 100	200 400	01
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	5.0	965 901	h _{oe}	1.0	40	μmhos
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 1.0 k ohms, f = 10 Hz to 15.7 kHz)		2N3903 2N3904	NF	=	6.0 5.0	dB

SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 3.0 \text{ Vdc}, V_{BE} = 0.5 \text{ Vdc},$		t _d	35	ns
Rise Time	I _C = 10 mAdc, I _{B1} = 1.0 mAdc)	58	tr	35	ns
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mAdc,	2N3903	ts	175	ns
	$I_{B1} = I_{B2} = 1.0 \text{ mAdc}$	2N3904		200	
Fall Time			tf	50	ns

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

FIGURE 1 - DELAY AND RISE TIME **EQUIVALENT TEST CIRCUIT**

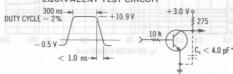
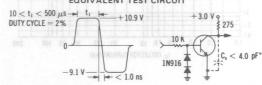


FIGURE 2 - STORAGE AND FALL TIME **EQUIVALENT TEST CIRCUIT**



*Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

--- TJ = 25°C --- TJ = 125°C

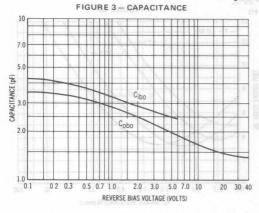
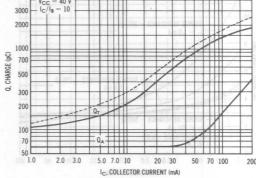
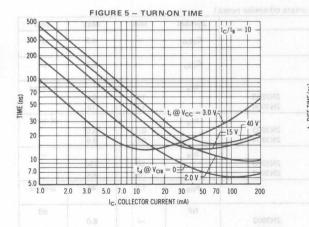
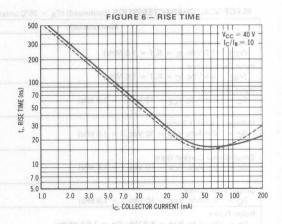


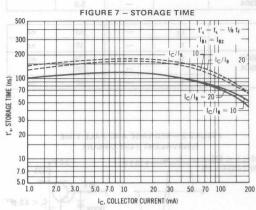


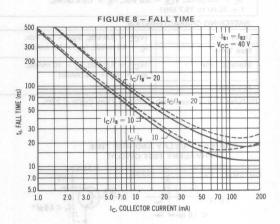
FIGURE 4 - CHARGE DATA



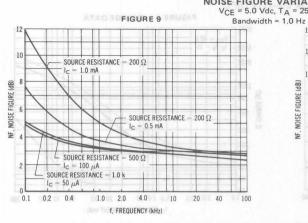


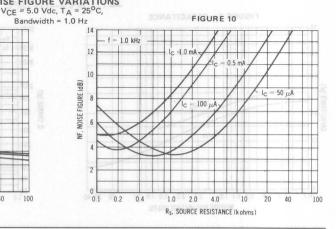


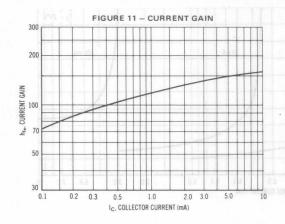


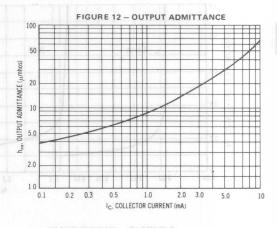


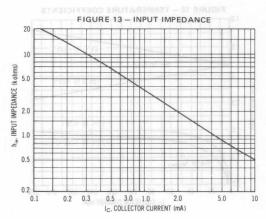
TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

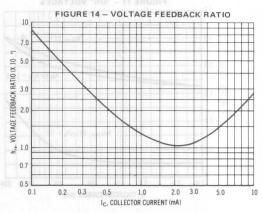


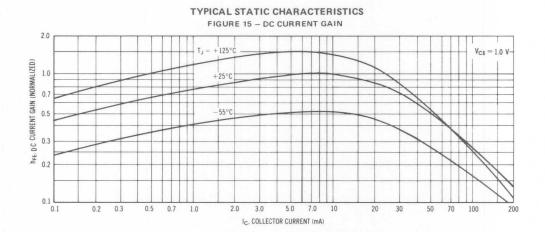




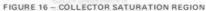








MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



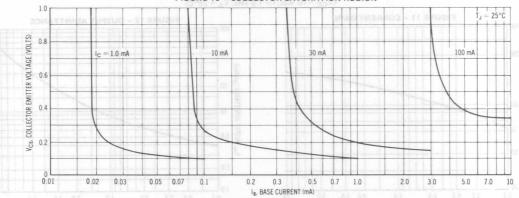


FIGURE 17 - "ON" VOLTAGES

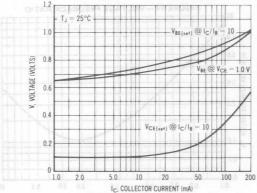
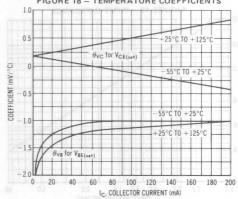
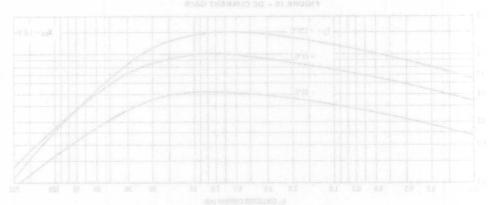


FIGURE 18 - TEMPERATURE COEFFICIENTS



TRICAL STATIC CHARACTERISTICS



MAXIMUM RATINGS

MAXIMOM NATINGO	0.63100	THE PERSON NAMED IN	1 4 144
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	IC	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD PD	625 5.0	mW/°C
Total Power Dissipation @ TA = 60°C	PD	250	mW
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

2N3905 2N3906

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	2066NI		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	200504		Of a place of	- 33VI		and the
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	Nasage		V(BR)CEO	40		Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc$, $I_E = 0$)		V(BR)CBO	40		Vdc	
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)			V _{(BR)EBO}	5.0	8U0 1 3	Vdc
Base Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 3.0 Vdc)			IBL	_	50	nAdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 3.0 Vdc)			ICEX	860.1	50	nAdc
ON CHARACTERISTICS(1)			10 00 = 21 12		1	
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc)	$<$ h $<$ 500 μs NOTY CYCLE = 2 % of μg and cannot	2N3905 2N3906	hFE 1 30	30 60	- Vaoi	_
($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)		2N3905 2N3906	PHAST	40 80	=	
				50 100	150 300	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		2N3905 2N3906	CITARICE	30 60	HHT.	
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		2N3905 2N3906		15 30		
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)	1080		VCE(sat)	010)	0.25 0.4	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)	0.00		V _{BE} (sat)	0.65	0.85 0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS	200					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	901	2N3905 2N3906	fŢ	200 250	İ	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)		66 88	C _{obo}	0.5 0.1	4.5	pF

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	tiaU	pulcV	los	Symbol	Min	Max	Unit
Input Capacitance	DOV	01-	0	Cibo	_	10.0	pF
$(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$		- 04	0	ggV IDO	Total Control	agelloV seal	i- otaslio3
Input Impedance	Velo		0	hie		agatioV ea	k ohms
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$		2N3905 2N3906		0	0.5 2.0	8.0 12	
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	3 Wm.	2N3905		h _{re}	0.1	5.0	X 10-4
		2N3906		29 2	0.1	10	
Small-Signal Current Gain	Watts.	1.5		h _{fe}	10 = 20 m	e Dissipation	n, atl late l
nall-Signal Current Gain II _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)		2N3905			50	200	
6258	30	2N3906	nt:	Fat	100	400	paintneg@
Output Admittance				hoe		ture Range	μmhos
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$		2N3905 2N3906			1.0 3.0	40 60	
Noise Figure	tinU	vertil.	lios	NF	tile	Characteria	dB
$(I_C = 100 \mu Adc, V_{CE} = 5.0 \text{ Vdc}, R_S = 1.0 \text{ k ohm}, f = 10 \text{ Hz to } 15.7 \text{ kHz})$		2N3905 2N3906		AR :	sisD o <u>i n</u> oit	5.0 4.0	
THE PART OF THE PA	UKKING	180/08	1 .	- CO Service	len Kont mout	SHEET STREET, ST.	Chemian

SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 3.0 \text{ Vdc}, V_{BE} = 0.5 \text{ Vdc})$		td		35	ns
Rise Time	$I_C = 10 \text{ mAdc}, I_{B1} = 1.0 \text{ mAdc})$	Usion esignarito sasim	State trans	STEMBTS	35	ns
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mAdc,	2N3905 2N3906	t _S	_	200 225	ns
Fall Time	I _{B1} = I _{B2} = 1.0 mAdc)	2N3905 2N3906	t _f	rgstlo <u>V</u> nwat	60 75	ns

(1) Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

FIGURE 1 – DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

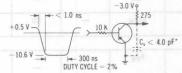
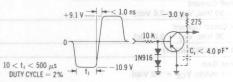
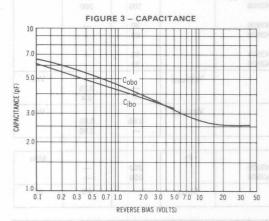


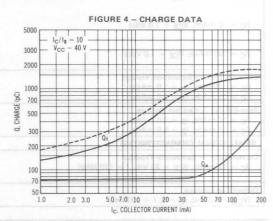
FIGURE 2 – STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT

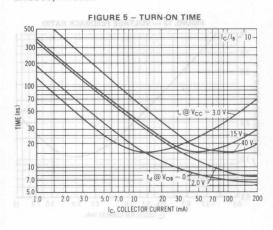


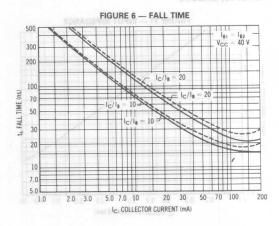
*Total shunt capacitance of test jig and connectors

TRANSIENT CHARACTERISTICS T_J = 25°C --- T_J = 125°C



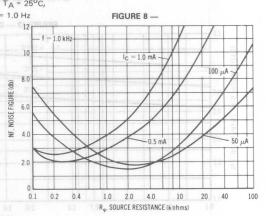






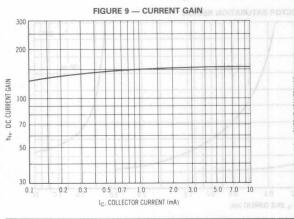
AUDIO SMALL SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

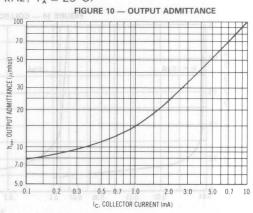
VCE = 5.0 Vdc, TA = 25°C, Bandwidth = 1.0 Hz FIGURE 7 -5.0 4.0 SOURCE RESISTANCE = 200Ω $I_C = 1.0 \, \text{mA}$ 8.0 (qp) NOISE FIGURE (dB) NOISE FIGURE SOURCE RESISTANCE = 200 Ω $I_C = 0.5 \, \text{mA}$ 6.0 ₩ 4.0 ¥ SOURCE RESISTANCE 1.0 $I_C = 100 \mu A$ SOURCE RESISTANCE = 2.0 k 2.0 50 μA 2.0 4.0 10 40 f, FREQUENCY (kHz)



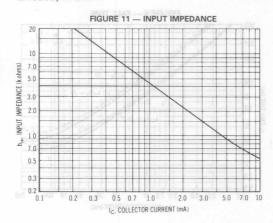
h PARAMETERS

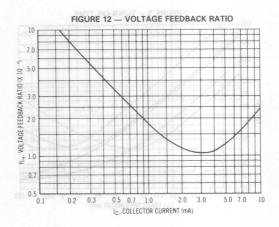
 $(V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}, T_A = 25^{\circ}\text{C})$



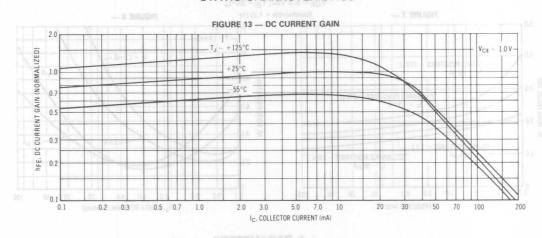


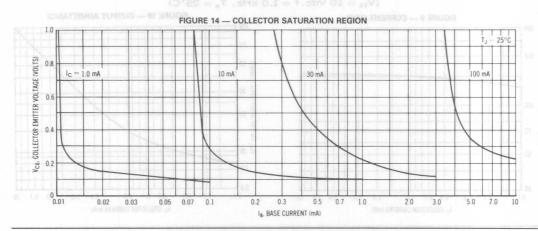
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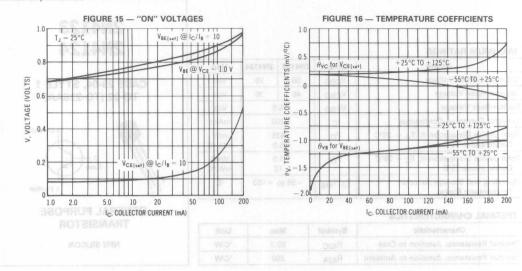
STATIC CHARACTERISTICS





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





2NA123 2NA124		

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

MAXIMUM RATINGS

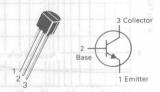
Rating	Symbol	2N4123	2N4124	Unit
Collector-Emitter Voltage	VCEO	30	25	Vdc
Collector-Base Voltage	VCBO	40	30	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	200		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD 1.5		Watt mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

2N4123 2N4124

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) $(I_C = 1.0 \text{ mAdc}, I_E = 0)$	2N4123 2N4124	V(BR)CEO	30 25	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	2N4123 2N4124	V(BR)CBO	40 30	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V _{(BR)EBO}	5.0	_	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)		ICBO	-	50	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)		I _{EBO}	-	50	nAdo
ON CHARACTERISTICS					
DC Current Gain(1) $(I_C = 2.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4123 2N4124	hFE	50 120	150 360	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4123 2N4124		25 60	=	
Collector-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{CE(sat)}		0.3	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{BE(sat)}	_	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS			7.1		
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	2N4123 2N4124	fT	250 300	=	MHz
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_{E} = 0$, $f = 100 \text{ MHz}$)		C _{obo}	-	4.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0 , f = 100 kHz)		C _{ibo}		8.0	pF
Collector-Base Capacitance (I _E = 0, V _{CB} = 5.0 V, f = 100 kHz)		C _{cb}		4.0	pF
Small-Signal Current Gain $(I_C = 2.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N4123 2N4124	h _{fe}	50 120	200 480	-

2N\$123, 2N4124

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	"1 XHN 1 = 1 N O1 =	Symbol	Min	Max	Unit
Current Gain — High Frequency		hfe			102
(I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	2N4123		2.5		
	2N4124		3.0	-	
(I _C = 2.0 mAdc, V _{CE} = 10 V, f = 1.0 kHz)	2N4123		50	200	CAS
$(I_C = 2.0 \text{ mAdc}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz})$	2N4124		120	480	
Noise Figure		NF			dB
$(I_C = 100 \mu Adc, V_{CE} = 5.0 Vdc, R_S = 1.0 kohm,$	2N4123			6.0	
Noise Bandwidth = 10 Hz to 15.7 kHz)	2N4124			5.0	0.001

⁽¹⁾ Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

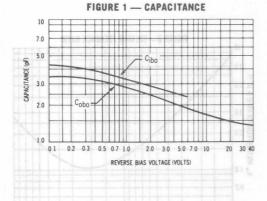
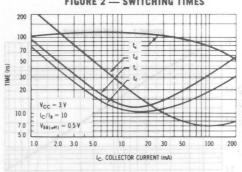
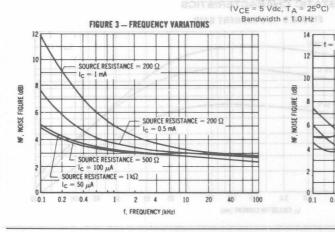


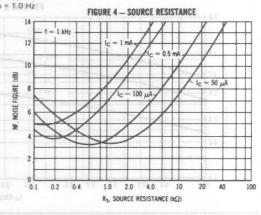
FIGURE 2 - SWITCHING TIMES



AUDIO SMALL SIGNAL CHARACTERISTICS

NOISE FIGURE

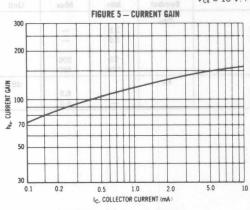


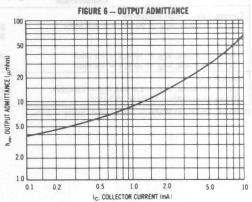


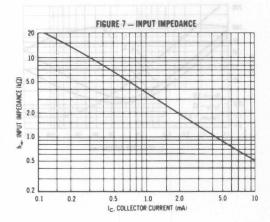
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

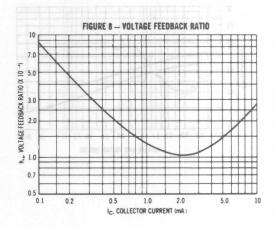
h PARAMETERS AT HOUSE CONTRIBUTION AND LACHTOS. ER

VCE = 10 V, f = 1 kHz, TA = 25°C

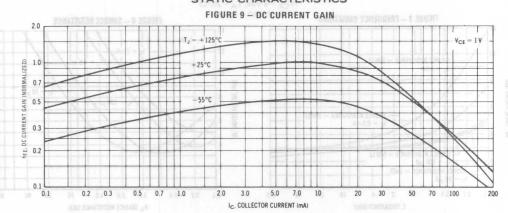


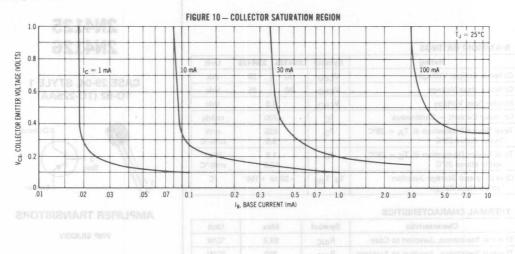


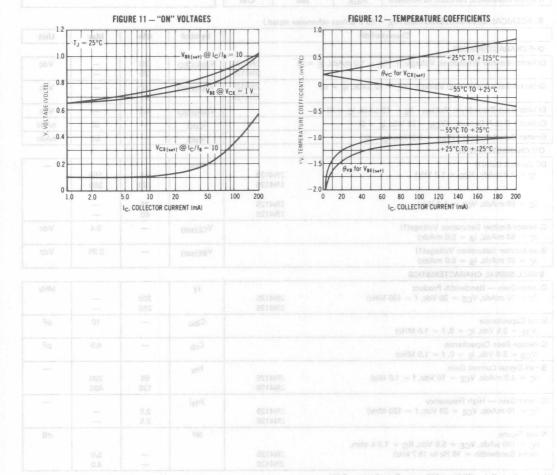




STATIC CHARACTERISTICS







Rating	Symbol	2N4125	2N4126	Unit
Collector-Emitter Voltage	VCEO	30	25	Vdc
Collector-Base Voltage	VCBO	30	25	Vdc
Emitter-Base Voltage	VEBO	4	4.0	
Collector Current — Continuous	Ic	2	200	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1	25 .0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		1.5 12.0	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

2N4125 2N4126

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

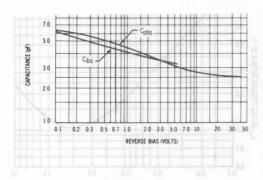


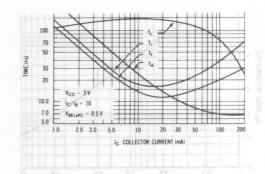
AMPLIFIER TRANSISTORS

PNP SILICON

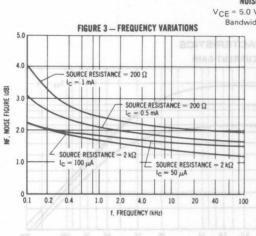
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

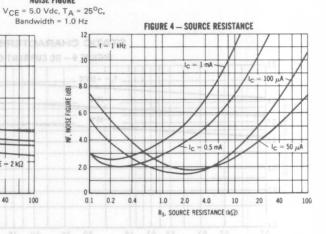
Characteristic			Min	Max	Unit
OFF CHARACTERISTICS	at at				0.1
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _E = 0)	2N4125 2N4126	V(BR)CEO	30 25		Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	2N4125 2N4126	V(BR)CBO	30 25		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	4.0	-	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)		ІСВО		50	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)		IEBO		50	nAdc
ON CHARACTERISTICS		101 - 81/5/100 Ites	183/		
DC Current Gain(1) (I _C = 2.0 mAdc, V _{CE} = 1.0 Vdc)	2N4125 2N4126	hFE	50 120	150 360	_
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4125 2N4126	20 BD WRENT HALL	25 60	0:5.	4.1
Collector-Emitter Saturation Voltage(1) (IC = 50 mAdc, IB = 5.0 mAdc)		VCE(sat)	-	0.4	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{BE(sat)}	-	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product $(I_C = 10 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz})$	2N4125 2N4126	fT	200 250	_	MHz
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MHz)		C _{ibo}	_	10	pF
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)		C _{cb}	-	4.5	pF
Small-Signal Current Gain (IC = 2.0 mAdc , VCE = 10 Vdc , f = 1.0 kHz)	2N4125 2N4126	h _{fe}	50 120	200 480	_
Current Gain — High Frequency (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	2N4125 2N4126	h _{fe}	2.0 2.5	_	_
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _G = 1.0 k ohm, Noise Bandwidth = 10 Hz to 15.7 kHz)	2N4125 2N4126	NF	_	5.0 4.0	dB





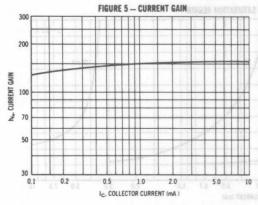
AUDIO SMALL SIGNAL CHARACTERISTICS NOISE FIGURE

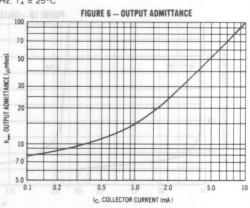


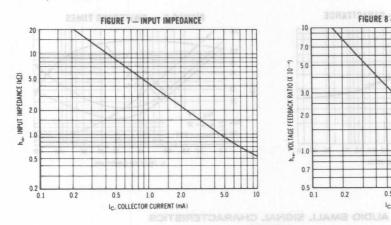


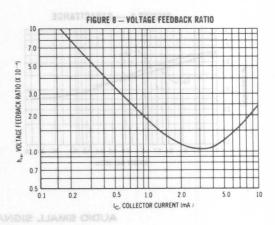
h PARAMETERS

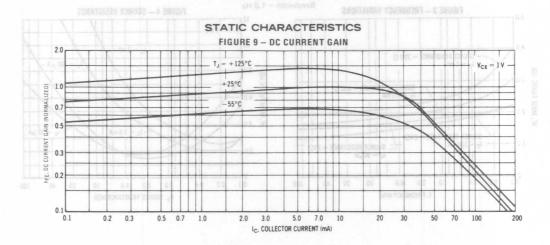
 $V_{CE} = 10 \text{ V, f} = 1 \text{ kHz. T}_A = 25^{\circ}\text{C}$

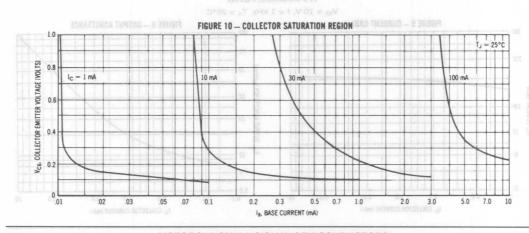


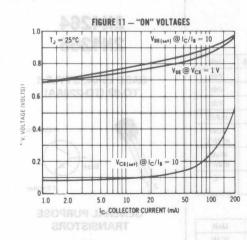


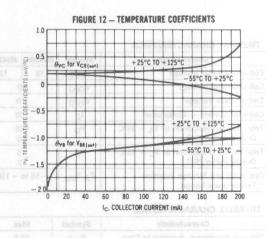












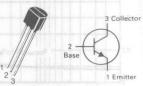
THERMAL CHARACTERISTICS Symbol 2N4264 2N4265 Characteristic Unit Collector-Emitter Voltage Vdc VCEO Collector-Base Voltage Vdc VCBO 30 Emitter-Base Voltage Vdc **VEBO** 6.0 Collector Current — Continuous Ic 200 mAdc Total Device Dissipation @ TA = 25°C PD 625 mW Derate above 25°C 5.0 mW/°C Total Device Dissipation @ T_C = 25°C PD. 1.5 Watts Derate above 25°C 12 mW/°C Operating and Storage Junction TJ, Tstg -55 to +150 °C Temperature Range

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

LIVITLUU



GENERAL PURPOSE TRANSISTORS

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage $(I_C = 1.0 \text{ mAdc}, I_E = 0)$	2N4264 2N4265	V(BR)CEO	15 12	_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)		V _(BR) CBO	20	T	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		V _{(BR)EBO}	6.0	_	Vdc
Base Cutoff Current (V _{CE} = 12 Vdc, V _{EB(off)} = 0.25 Vdc) (V _{CE} = 12 Vdc, V _{EB(off)} = 0.25 Vdc, T _A = 100°C)		IBEV		0.1 10	μAdc
Collector Cutoff Current (V _{CE} = 12 Vdc, V _{EB(Off)} = 0.25 Vdc)		ICEX	-	100	nAdc
ON CHARACTERISTICS					
DC Current Gain ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	2N4264 2N4265	hFE	25 30	=	_
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4264 2N4265		40 100	160 400	
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^{\circ}C)$	2N4264 2N4265		20 45	=	
$(I_C = 30 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4264 2N4265		40 90	=	
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})(1)$	2N4264 2N4265		30 55	=	
$(I_C = 200 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})(1)$	2N4264 2N4265		20 35	Ξ	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 100 \text{ mAdc}$, $I_B = 10 \text{ mAdc}$)(1)		V _{CE} (sat)	=	0.22 0.35	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)(1)		V _{BE(sat)}	0.65 0.75	0.80 0.95	Vdc

Current-Gain — Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f = 100 MHz)	fT	350		MHz	
Input Capacitance (V _{BE} = 0.5 Vdc, I _C = 0, f = 1.0 MHz)		Cibo	1+1	8.0	pF
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	15 × 115 °C	C _{cb}	+	4.0	pF

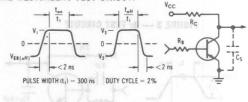
		-	The same of the sa		
Delay Time	(V _{CC} = 10 Vdc, V _{EB(off)} = 2.0 Vdc,	td		8.0	ns
Rise Time	I _C = 100 mAdc, I _{B1} = 10 mAdc) (Fig. 1, Test Condition C)	tr	4	15	ns
Storage Time	V _{CC} = 10 Vdc, (I _C = 10 mAdc, for t _s)	ts		20	ns
Fall Time	$(I_C = 100 \text{ mA for t}_f)$ $I_{B1} = I_{B2} = 10 \text{ mAdc})$ (Fig. 1, Test Condition C)		++-	15	ns
Turn-On Time	(V _{CC} = 3.0 Vdc, V _{EB(off)} = 1.5 Vdc, I _C = 10 mAdc, I _{B1} = 3.0 mAdc) (Fig. 1, Test Condition A)	ton		25	ns
Turn-Off Time	$(V_{CC}=3.0\ Vdc,\ I_C=10\ mAdc,\ I_{B1}=3.0\ mAdc,\ I_{B2}=1.5\ mAdc)$ (Fig. 1, Test Condition A)	toff	0E 0.1	35	01 ns
Storage Time	(V _{CC} = 10 Vdc, I _C = 10 mA I _{B1} = I _{B2} = 10 mAdc) (Fig. 1, Test Condition A)	t _S	TTI	20	ns
Total Control Charge	$(V_{CC} = 3.0 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B} = \text{mAdc})$ (Fig. 1, Test Condition B)	QΤ		80	pC

(1) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

CMALL CICNIAL CHARACTERISTICS

FIGURE 1 - SWITCHING TIME EQUIVALENT TEST CIRCUIT

TEST CONDITION	Ic	Vcc	RB	Rc	C _{S(max)}	V _{EB(off)}	٧,	V ₂	٧,
	mA	٧	Ω	Ω	pF	٧	٧	٧	٧
A	10	3	3300	270	4	-1.5	10.55	-4.15	10.70
B	10	10	560	960	4	-/	-	-4.65	6.55
C	100	/10	560	96	12	-2.0	6.35	-4.65	6.55



E RESIDE

If I, were suddenly influenced. The manufator would continue to combuild until 0, is semoved from the editive regions through an external geth or through influents exceptionation. Since the internal seconditions then the tony compared to the ultimate capability of a transistor, a strange, 0, as opposite optimity equal in magnitude, can be street on strange, 0, as opposite, 0, to neutralize the internal charge and considerably educes the time off time of the transistor. Figure 3 shows the rest insuit and figure 4 the turn of weedown flows (0, to the rest insuit and figure 4 the turn of weedown flows (0, to the property of C = 0, 4, 6, 4, where V is defined in Ferra 3. When a translatur is hald in a conductive state by a base current, a strange, $Q_{\rm e}$ is theveloped or "stored" in the transister, $Q_{\rm e}$ may be obtained $Q_{\rm e} = Q_{\rm e} + Q_{\rm e} + Q_{\rm e} + Q_{\rm e}$. As the charge required to develop the required collector corrupt his charge is primarily a function of super cutoff insquancy, $Q_{\rm e}$ is the charge the considerables feetback expectity, $Q_{\rm e} = Q_{\rm

The charge required to turn a runniarior "on" to the edge of each about the sum of Q_i and Q_i which is defined as the active region are. Q_i , $Q_i = \{ j_i \xi_i \}$ when the transistor is criven by a constant our ξ_i .

FIGURE 2 - MINIMUM CURRENT GAIN

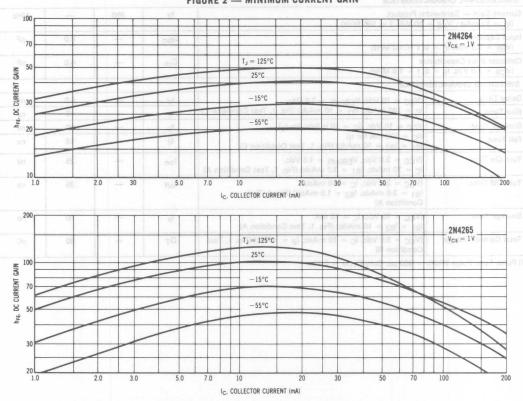


FIGURE 3 - QT TEST CIRCUIT

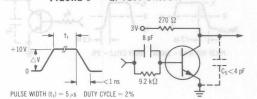
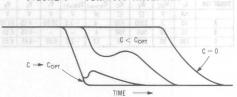


FIGURE 4 - TURN-OFF WAVEFORM



NOTE 1

When a transistor is held in a conductive state by a base current,

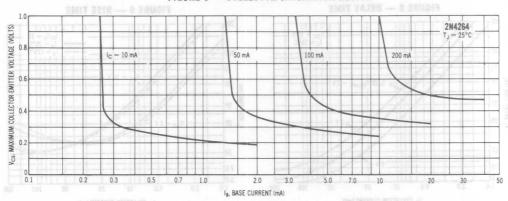
which a transitor is lief in a conductive state by a base current, I_s , a charge, Q_s , is developed or "stored" in the transistor. Q_s may be written: $Q_s = Q_t + Q_v + Q_s$. Q_t is the charge required to develop the required collector current. This charge is primarily a function of alpha cutoff frequency. Q_v is the charge required to charge the collector-base feedback capacity. Q_s is express charge resulting from everything i.e. operation in Qx is excess charge resulting from overdrive, i.e., operation in

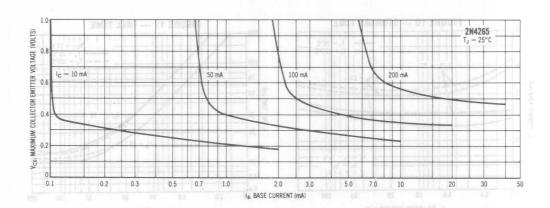
 Q_X is excess charge resulting from overdrive, i.e., operation in saturation. The charge required to turn a transistor "on" to the edge of saturation is the sum of Q_1 and Q_2 which is defined as the active region charge, Q_A . $Q_A = I_{\rm B} t$, when the transistor is driven by a constant current step (I_81) and I_81 < $< \frac{I_C}{h_{EE}}$

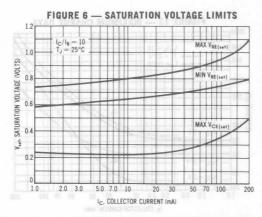
If I₈ were suddenly removed, the transistor would continue to conduct until Qs is removed from the active regions through an external path or through internal recombination. Since the internal recombination time is long compared to the ultimate capability of a transistor, a charge, Q_{T} , of opposite polarity, equal in magnitude, can be stored on an external capacitor, C, to neutralize the internal charge and considerably reduce the turn-off time of the transistor. Figure 3 shows the test circuit and Figure 4 the turn-off waveform. Given Q_T from Figure 13, the external C for worst-case turn-off in any circuit is: $C=Q_{\scriptscriptstyle T}/_{\textstyle \bigtriangleup} V,$ where ${\textstyle \bigtriangleup} V$ is defined in Figure 3.

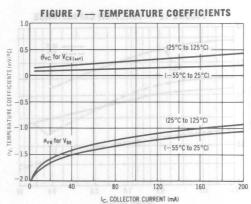
"ON" CONDITION CHARACTERISTICS

FIGURE 5 — COLLECTOR SATURATION REGION



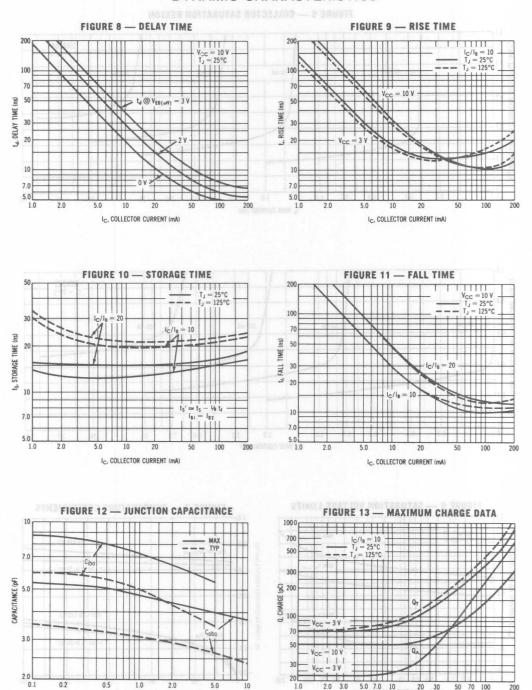






MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

DYNAMIC CHARACTERISTICS



Ic, COLLECTOR CURRENT (mA)

REVERSE BIAS (Vdc)

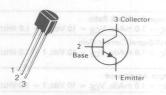
MAXIMUM RATINGS				
Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	VCEO	40	Vdc	
Collector-Base Voltage	VCBO	60	Vdc	
Emitter-Base Voltage	VEBO	6.0	Vdc	
Collector Current — Continuous	saff IC	600	mAdc	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD PD	625 5.0	mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

ZN44U1

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

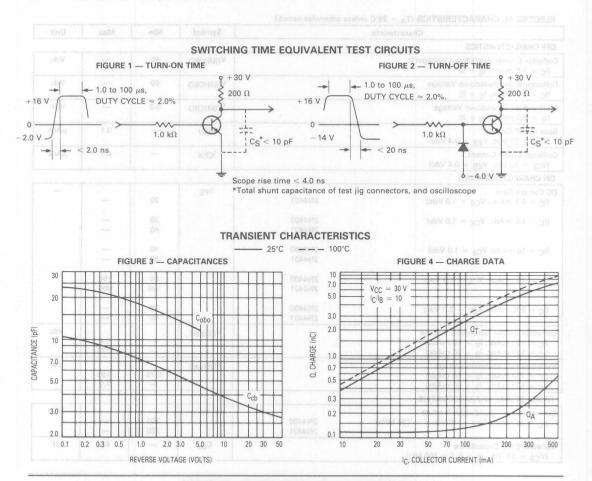
ELECTRICAL CHARAC	TERISTICS (TA =	25°C unless	otherwise noted.)	
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Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	T THE EAST ON THE THE	SUBLICATIONS			
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)		V(BR)CEO	40	FERUDIA	Vdc
Collector-Base Breakdown Voltage (IC = 0.1 mAdc, IE = 0)		V(BR)CBO	60	001 of 0.1 ++	Vdc
mitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	1400	V(BR)EBO	6.0	JEG YEAR	Vdc
lase Cutoff Current (VCE = 35 Vdc, VEB = 0.4 Vdc)	V M = Ra dT > 20	IBEV	130 KD	0.1	μAdc
Collector Cutoff Current (V _{CE} = 35 Vdc, V _{EB} = 0.4 Vdc)		ICEX	-	0.1	μAdc
ON CHARACTERISTICS(1)	on 0.4 > notified no	100 A			
OC Current Gain euroscolioso bris anoteennoo gil $(I_C = 0.1 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4401	hFE	20	-	-
(IC = 1.0 mAdc, V_{CE} = 1.0 Vdc)	2N4400 2N4401	AZET	20 40	=	
(I _C = 10 mAdc, V _{CE} = 1.0 Vdc)	2N4400 2N4401	SECTATIONS	40 80	UDIR -	
($I_C = 150 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	2N4400 2N4401		50 100	150 300	DE
(I _C = 500 mAdc, V_{CE} = 2.0 Vdc)	2N4400 2N4401	0002	20 40		
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	0.00	VCE(sat)		0.4 0.75	Vdc
Base-Emitter Saturation Voltage ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)		VBE(sat)	0.75	0.95 1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS	6.0		++++		-
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	2N4400 2N4401	fT	200 250		MHz
Collector-Base Capacitance (VCB = 5.0 Vdc, I _E = 0, f = 100 kHz)	00 30 30 10.	C _{cb}	0.9 - 0.1	80 6.5	pF

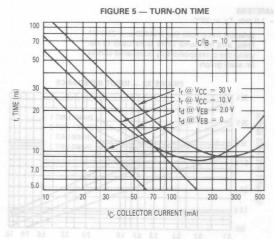
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

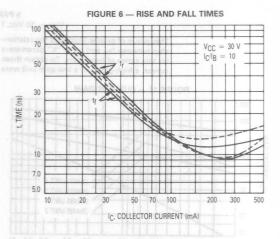
IUP	Characteristic			Symbol	Min	Max	Unit
Emitter-Base Capacitance (VBF = 0.5 Vdc, IC = 0,	f = 100 kHz)			C _{eb}	-	30	pF
Input Impedance (IC = 1.0 mAdc, VCE = 10 Vdc, f = 1.0 kHz)			N4400	Olo hie	0.5	9(7.5	k ohms
		phy 2	N4401	onaV	1.0	15	roitter-Bass
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} =	10 Vdc, f = 1.0 kHz)			al hre	0.1,,,,,,,,	8.0	X 10-4
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)			N4400 N4401	h _{fe}	20	250	vn Is e ls ieO est Device
		2	N4401	Q ^N	40	500	als sived ten
Output Admittance (I _C = 1.0 mAdc, V _{CE} =	10 Vdc, f = 1.0 kHz)			hoe	1.0 nodon	JA 30	μmhos
SWITCHING CHARACTERI	STICS					- segonymen	
Delay Time	(V _{CC} = 30 Vdc, V _{EB} = 2			td	auras	15	ns
Rise Time	$I_C = 150 \text{ mAdc}, I_{B1} = 150 \text{ mAdc}$	mAdc)		o demote	pit	20	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 150	mAdc,	63.3	t _s	ion yo Case	225	ns
Fall Time	$I_{B1} = I_{B2} = 15 \text{ mAdc}$			sugest f	eisten 6 och soci	30	ns

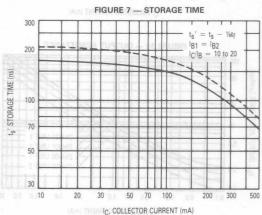
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

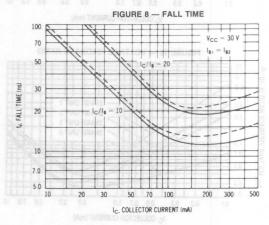


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

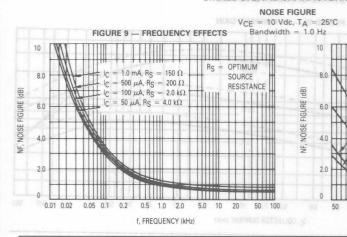


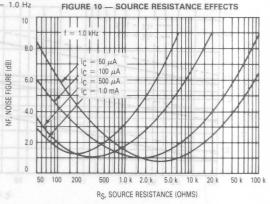




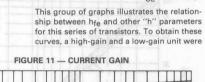


SMALL-SIGNAL CHARACTERISTICS

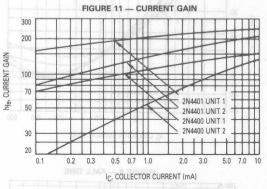


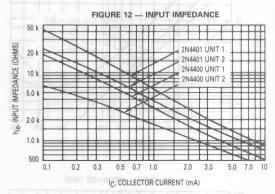


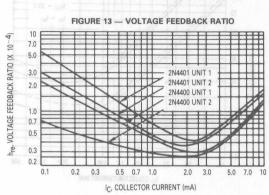
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

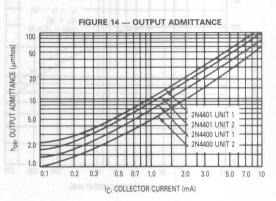


selected from both the 2N4400 and 2N4401 lines, and the same units were used to develop the correspondingly numbered curves on each graph.



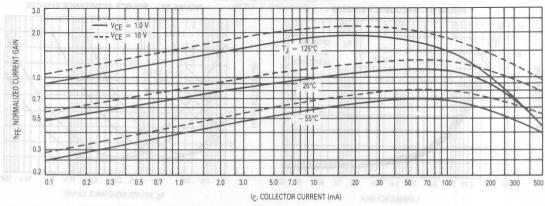


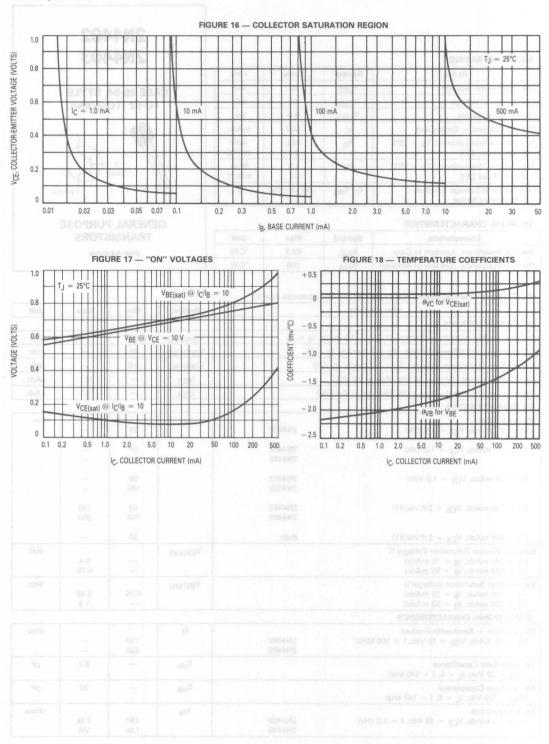




STATIC CHARACTERISTICS

FIGURE 15 - DC CURRENT GAIN





MAXIMUM RATINGS Value Unit Symbol Rating Collector-Emitter Voltage VCEO 40 Vdc 40 Vdc Collector-Base Voltage VCBO Emitter-Base Voltage VEBO 5.0 Vdc 600 mAdc Collector Current — Continuous IC Total Device Dissipation @ TA = 25°C PD 625 mW Derate above 25°C 5.0 mW/°C 1.5 Watt Total Device Dissipation @ T_C = 25°C PD mW/°C Derate above 25°C 12 Operating and Storage Junction -55 to +150 °C TJ, Tstg

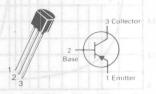
THERMAL CHARACTERISTICS

Temperature Range

THE MINE OF PRINCIPO								
Characteristic	Symbol	Max	Unit					
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W					
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	200	°C/W					

2N4402 2N4403

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTORS

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	20- 10				
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc	, I _B = 0)	V(BR)CEO	40		Vdc
Collector-Base Breakdown Voltage (IC = 0.1 mAdc, IE =	= 0)	V(BR)CBO	40		Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C =	0)	V(BR)EBO	5.0		Vdc
Base Cutoff Current (V _{CE} = 35 Vdc, V _{BE} = 0.4 Vdc)	21- 8 N III	IBEV		0.1	μAdc
Collector Cutoff Current (V _{CE} = 35 Vdc, V _{BE} = 0.4 Vdc		ICEX		0.1	μAdc
ON CHARACTERISTICS	ns Helste		of a glot	W (tests)V	2.0
DC Current Gain (IC = 0.1 mAdc, V _{CE} = 1.0 Vdc)	2N4403	hFE	30		
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4402 2N4403	08 05 01 (Am) TVISOUE)	30 60	ar a <u>n</u>	0 11
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N4402 2N4403		50 100	Ξ.	
$(I_C = 150 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc})(1)$	2N4402 2N4403		50 100	150 300	
$(I_C = 500 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc})(1)$	Both		20	_	
Collector-Emitter Saturation Voltage(1) ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)		VCE(sat)	=	0.4 0.75	Vdc
Base-Emitter Saturation Voltage(1) (IC = 150 mAdc, IB = 15 mAdc) (IC = 500 mAdc, IB = 50 mAdc)		V _{BE(sat)}	0.75	0.95 1.3	Vdc
SMALL-SIGNAL CHARACTERISTICS					•
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	2N4402 2N4403	fT	150 200	_	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 140 kHz)		C _{cb}		8.5	pF
Emitter-Base Capacitance $(V_{BE}=0.5 \text{ Vdc}, I_{C}=0, f=140 \text{ kHz})$		C _{eb}	_	30	pF
Input Impedance (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N4402 2N4403	h _{ie}	750 1.5k	7.5k 15k	ohms

Storage Time

Fall Time

225

30

ns

tf

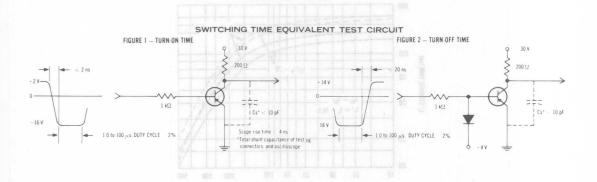
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

(VCC = 30 Vdc, IC = 150 mAdc,

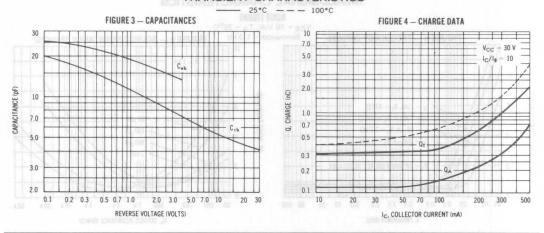
 $I_{B1} = I_{B2} = 15 \text{ mAdc}$

	Characteristic	3 001	4 1 1 1	Symbol	Min	Max	Unit
Voltage Feedback F (I _C = 1.0 mAdc,	Ratio VCE = 10 Vdc, f = 1.0 kHz)	- m	01 = e(\c	h _{re}	0.1	8.0	X 10-4
Small-Signal Curre (I _C = 1.0 mAdc,	nt Gain V _{CE} = 10 Vdc, f = 1.0 kHz)	2N4402 2N4403	V 06 -	hfe	30 60	250 500	7-
Output Admittance (I _C = 1.0 mAdc,	V _{CE} = 10 Vdc, f = 1.0 kHz)	96 SS	V01 = V04	h _{oe}	1.0	100	μmhos
SWITCHING CHAR	ACTERISTICS	3 /	0 = 100	DECK DIE THE			
Delay Time (V _{CC} = 30 Vdc, V _{BE} = 2.0 Vdc,			NI	td	1 -7	15	ns
Rise Time	$I_C = 150 \text{ mAdc}, I_{B1} = 15 \text{ mag}$	mAdc)		tr		20	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

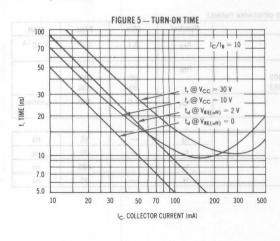


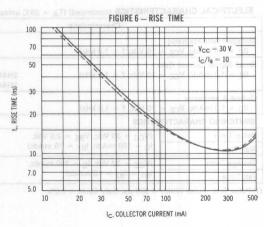
TRANSIENT CHARACTERISTICS

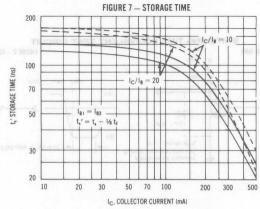


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

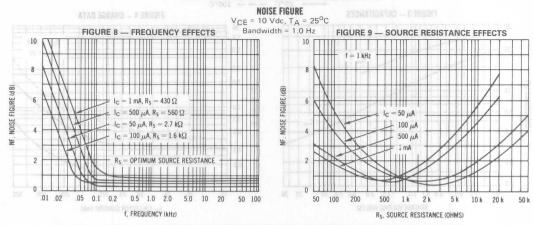
2





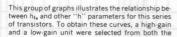


SMALL-SIGNAL CHARACTERISTICS

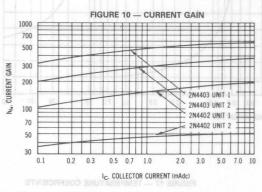


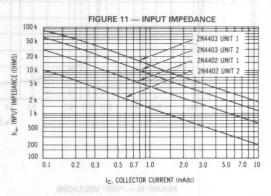
h PARAMETERS

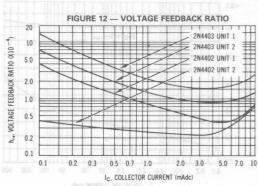
V_{CE} = 10 Vdc, f = 1 kHz, T_A = 25°C

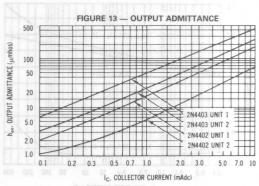


2N4402 and 2N4403 lines, and the same units were used to develop the correspondingly-numbered curves on each graph.









STATIC CHARACTERISTICS

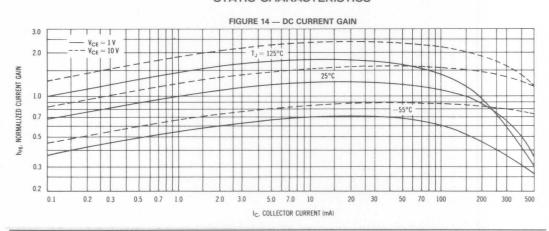


FIGURE 15 — COLLECTOR SATURATION REGION

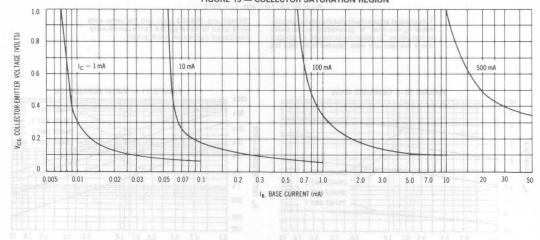


FIGURE 16 — "ON" VOLTAGES

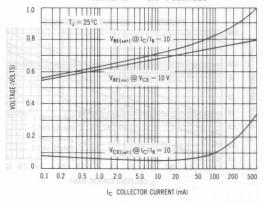
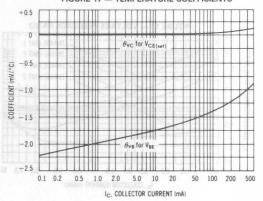
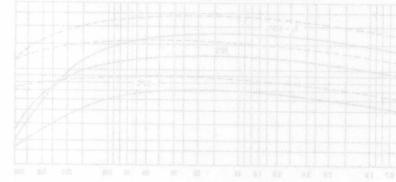


FIGURE 17 — TEMPERATURE COEFFICIENTS



IGURE 14 - OC CURRENT GAIN



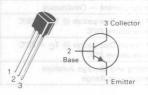
Rating	Symbol	2N4409	2N4410	Unit
Collector-Emitter Voltage	VCEO	50	80	Vdc
Collector-Base Voltage	VCBO	80	120	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	IC	250		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

2N4409 2N4410

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

NPN SILICON

Refer to 2N5550 for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			Solve II	3 0
Collector-Emitter Breakdown Voltage(1) 2N4409 (I _C = 1.0 mAdc, I _B = 0) 2N4410	V(BR)CEO	50 80	mAde, lg = 0 sa Br <u>ea</u> kdow	Vdc
Collector-Emitter Breakdown Voltage (IC = 500 μ Adc, VBE = 5.0 Vdc, RBE = 8.2 kohms) 2N4409 2N4410	V(BR)CEX	80 120	therroD float 0 + <u>pLo</u> bV 0	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$) 2N4409 2N4410	V(BR)CBO	80 120	ma <u>m</u> uD No 0 V8 <u>a_lc</u> = 8	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	5.0	CT 6H05 WCS Galla	Vdc
Collector Cutoff Current (VCB = 60 Vdc, IE = 0) (VCB = 60 Vdc, IE = 0, TA = 100°C) (VCB = 100 Vdc, IE = 0) (VCB = 100 Vdc, IE = 0, TA = 100°C) 2N4410 (VCB = 100 Vdc, IE = 0, TA = 100°C) 2N4410	ICBO	5.0 Vdc)	0.01 1.0 0.01 1.0	μAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	IEBO	5.0 Vac)(2)	0.1 _{6An}	μAdc
ON CHARACTERISTICS		ensiteV no	nitter Sanurati	Sontonik
DC Current Gain ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) $g(I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	hFE	60	400	II (gt) oduniš-sau
Collector-Emitter Saturation Voltage (I _C = 1.0 mAdc, I _B = 0.1 mAdc)	V _{CE(sat)}	3.0 Vdef -	0.2	Vdc
Base-Emitter Saturation Voltage (I _C = 1.0 mAdc, I _B = 0.1 mAdc)	V _{BE(sat)}	earrainet.	0.8	Vdc
Base-Emitter On Voltage (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	V _{BE(on)}	th Product	0.8	Vdc
SMALL-SIGNAL CHARACTERISTICS	(8)434-03	1 08V 0.8	= 35 Varion (108 = 20
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 30 MHz)	fT (s	60	300	MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 140 \text{ kHz}$, emitter guarded)	C _{cb}	5.0 Vdc, 1	12	pF
Emitter-Base Capacitance (V _{BE} = 0.5 Vdc, I_C = 0, f = 140 kHz, collector guarded)	C _{eb}		50	pF

(1) Pulse Test: Pulse Width \leq 300 μs , Duty Cycle \leq 2.0%.

(2) $f_T = |h_{fe}| \cdot f_{test}$.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	50	Vdc
Collector-Base Voltage	VCBO	50	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	lc	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

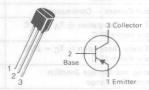
THERMAL CHARACTERISTICS

Characteristic Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	°C/W

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

2N5086 2N5087

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

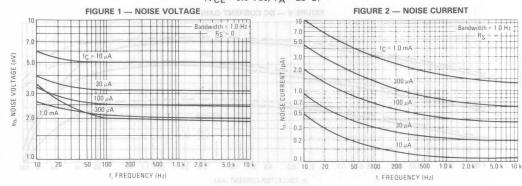
PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

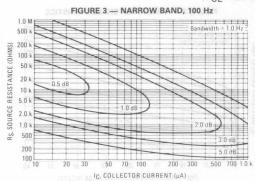
Characteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS	10/3/11/40		09911313616	no.		
Collector-Emitter Breakdown Voltage((I _C = 1.0 mAdc, I _B = 0)	2) 030/88)V		V(BR)CEO	50 legetle v nw	Cremerios reir Breekde	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)		OTABLES	V(BR)CBO	50	# <u>BI</u> (20A)	Vdc
Collector Cutoff Current ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 35 \text{ Vdc}$, $I_E = 0$)	XSDIRBIY	2N4499 2N4119	СВО	5.0 Vdc, Rg	10 50	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	CIBO(HB)*	2N4409	IEBO	sgallov i	50	nAdc
ON CHARACTERISTICS	nuarest			-smetlati	- Residence -	and anim
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	0eol	2N5086 2N5087 2N5086 2N5087	hFE	150 250 150 250	500 800	
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})(2)$		2N5086 2N5087		150 250	o Videdo = 0	ptus) sattim (V _{BI} = 4
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	nad		VCE(sat)	V shAm 0	0.3	Vdc
Base-Emitter On Voltage (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	VCEsst)	(abAm 1.0 = g) ,a	VBE(on)	6 måde. Vgr on Voltage	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (IC = 500 μ Adc, VCE = 5.0 Vdc f =	= 20 MHz)	0 Vdc)	F = apt abA	(0,1 40 ₍₁₀₎	on Voltage	MHz
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kH	z)		C _{cb}	h Product(2)	4.0 piwoned —	pF iso- smu
Small-Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ mAdc})$	= 1.0 kHz)	2N5086 2N5087	h _{fe}	150 250	600 900	ollector-bid (Vgs = 1
Noise Figure $(I_C = 20 \mu Adc, V_{CE} = 5.0 Vdc, R_S f = 10 Hz to 15.7 kHz)$	= 10 k ohms,	2143000	NF s, collector gue uty Cycle & 21		3.0 2.0	dB
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, R_S f = 1.0 \ kHz)$	= 3.0 k ohms,	2N5086 2N5087		_	3.0 2.0	

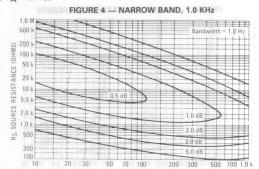
(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

TYPICAL NOISE CHARACTERISTICS (VCE = 5.0 Vdc, TA = 25°C)

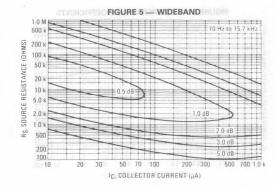


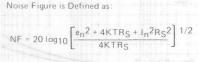
NOISE FIGURE CONTOURS (V_{CE} = 5.0 Vdc, T_A = 25°C)





IC, COLLECTOR CURRENT (µA)





en = Noise Voltage of the Transistor referred to the input, (Figure 3)

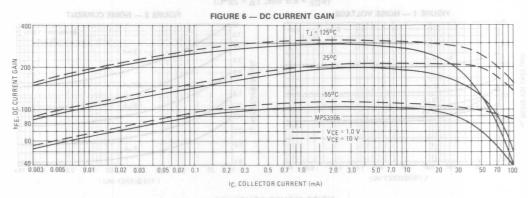
In = Noise Current of the transistor referred to the input (Figure 4)

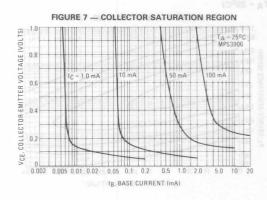
K = Boltzman's Constant (1.38 x 10⁻²³ j/°K)

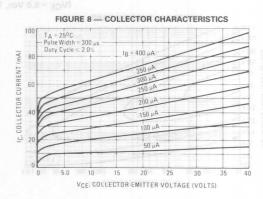
T = Temperature of the Source Resistance (°K)

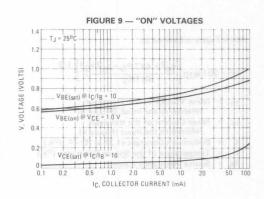
RS = Source Resistance (Ohms)

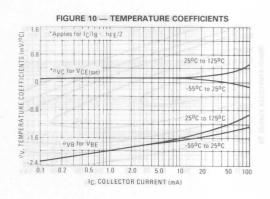
TYPICAL STATIC CHARACTERISTICS



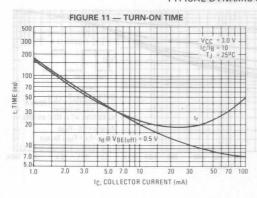


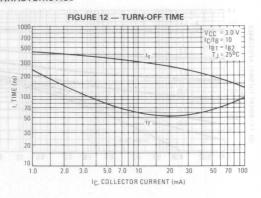


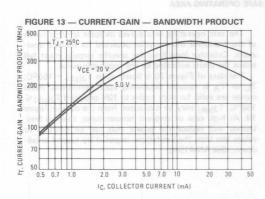


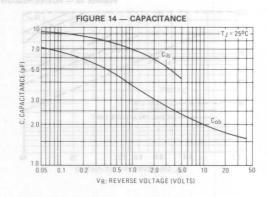


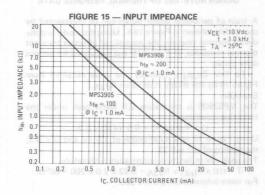
TYPICAL DYNAMIC CHARACTERISTICS

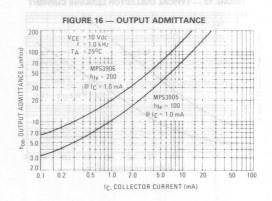












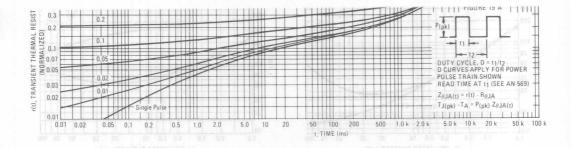
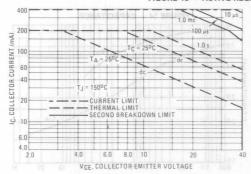


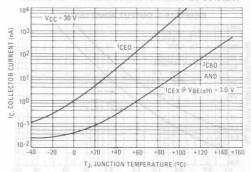
FIGURE 18 — ACTIVE-REGION SAFE OPERATING AREA



The safe operating area curves indicate IC-VCF limits of the transistor that must be observed for reliable operation. Collector load lines for specific circuits must fall below the limits indicated by the applicable curve.

The data of Figure 20 is based upon $T_{J(pk)} = 150^{\circ}C$; TC or TA is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided TJ(pk) ≤ 150°C. TJ(pk) may be calculated from the data in Figure 19. At high case or ambient temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown, (See AN-415A).

FIGURE 19 — TYPICAL COLLECTOR LEAKAGE CURRENT



DESIGN NOTE: USE OF THERMAL RESPONSE DATA

A train of periodical power pulses can be represented by the model as shown in Figure 19A. Using the model and the device thermal response the normalized effective transient thermal resistance of Figure 19 was calculated for various duty cycles.

To find $Z_{\theta JA(t)}$, multiply the value obtained from Figure 19 by the steady state value RAJA. Example:

The MPS3905 is dissipating 2.0 watts peak under the following conditions:

t1 = 1.0 ms, t2 = 5.0 ms (D = 0.2)Using Figure 19 at a pulse width of 1.0 ms and D = 0.2, the reading of r(t) is 0.22.

The peak rise in junction temperature is therefore

 $T = r(t) \times P(pk) \times R_{\theta}JA = 0.22 \times 2.0 \times 200 = 88^{\circ}C.$ For more information, see AN-569.

Rating	Symbol	2N5088	2N5089	Unit
Collector-Emitter Voltage	VCEO	30	25	Vdc
Collector-Base Voltage	VCBO	35	30	Vdc
Emitter-Base Voltage	VEBO	4 deby 4	.5	Vdc
Collector Current — Continuous	IC	50		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 336 W 12		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	°C/W

2N5088 2N5089

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSA18 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		all an extrave	1162		
Collector-Emitter Breakdown Voltage(2) ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	2N5088 2N5089	V(BR)CEO	30 25	con <u>Br</u> enkdo	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	2N5088 2N5089	V(BR)CBO	35 30	mate, ig. – e e. Bre <u>ek</u> edowi	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0) (V _{CB} = 15 Vdc, I _E = 0)	2N5088 2N5089	ІСВО	<u>an</u> atioV	50 50	nAdc
Emitter Cutoff Current $(V_{EB(off)} = 3.0 \text{ Vdc}, I_C = 0)$ $(V_{EB(off)} = 4.5 \text{ Vdc}, I_C = 0)$		IEBO	_	50 100	nAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc)	2N5088 2N5089	hFE	300 400	900 1200	IVET = 2.0
(I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	2N5088 2N5089		350 450	= 30 Y abAr	Coursetts (Ic = 2.0br
(I _C = 10 mAdc, V _{CE} = 5.0 Vdc)(2)	2N5088 2N5089		300 400	On Voltage Add, VCE = AL CHARAC	10 × 2.0 m
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		VCE(sat)	h Product 10 Vdc, f =	51w10.51 —	
Base-Emitter On Voltage (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)(2)		V _{BE} (on)	HM 0.1 - 1.		Vdc
SMALL-SIGNAL CHARACTERISTICS			9	e Capacitano	asG-rotus lo
Current-Gain — Bandwidth Product (I _C = 500 µAdc, V _{CE} = 5.0 Vdc, f = 20 MHz)		fT	50	Vac, <u>Is</u> = 0 a Time Cens	IVITIZ
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)		C _{cb}	== 1 (abV Qf	4.0	pF
Emitter-Base Capacitance (V _{BE} = 0.5 Vdc, I _C = 0, f = 100 kHz)	= WELSHIM OUT =	C _{eb}	In Age, HS	10	рЕ
Small-Signal Current Gain ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	2N5088 2N5089	h _{fe}	350 450		ro <u>illi</u> er Pou ('c = 2,0 m solo is mas
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 kohms, f = 10 Hz to 15.7 kHz)	2N5088 2N5089	NF	= 1	3.0 2.0	dB

(1) $R_{\theta,JA}$ is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%.

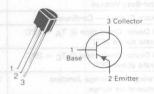
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	Ic	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	65 12	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	°C/W

2N5208

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

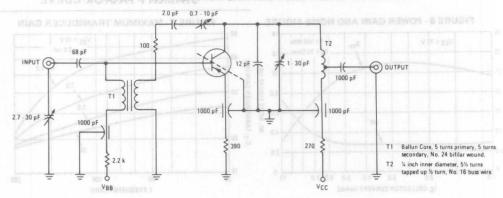
PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Chai	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	The second second	official as assessed	an Kan A E add	Chematical Com-	aladaeath cata	e Genetralk
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	OBJUNE	2N5089	V(BR)CEO	25	-	Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mAdc, I _E = 0)	OBJENE)*	2Neosb	V _(BR) CBO	30		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	083	sksoas	V _{(BR)EBO}	3.0		Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)	068		ICBO	F = 140163	10	nAdç
Emitter Cutoff Current (VBE = 2.0 Vdc, I _C = 0)	gqd	OGENIAL	IEBO	Septim a	100	nAdc
ON CHARACTERISTICS		21/15089		1000		
DC Current Gain (I _C = 2.0 mAdc, V _{CE} = 10 Vdc)		20008	hFE	20	120	0.1 = of
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 10 Vdc)			V _{BE(on)}	TO VabV 0.5	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS		21/6089				
Current-Gain — Bandwidth Product (I _C = 2.0 mAdc, V _{CE} = 10 Vdc, f = 1	00 MHz)		fT	300	1200	MHz
Input Capacitance (VBE = 2.0 Vdc, IC = 0, f = 1.0 MHz)			C _{ibo}	5,0 Vdq)[2]	0. 4.0 mO	
Collector-Base Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz)	4		C _{cb}		AFA1.0 JAV	pF
Collector Base Time Constant (I _E = 2.0 mAdc, V _{CB} = 10 Vdc, f = 3	11.8 MHz)		rb'C _c	E.O. Vezo, 1 =	10	ps of
Noise Figure (I _C = 2.0 mAdc, V _{CE} = 10 Vdc, R _S =	75 ohms, f = 1	100 MHz, BW = 1.0 MHz)	NF	HI 904 - 1.	3.0	dB
FUNCTIONAL TEST			0	100 KHz		
Amplifier Power Gain (IC = 2.0 mAdc, VCE = 10 Vdc, f = 1	00 MHz)	2145088	Gpe		Current Gal	

2

FIGURE 1 - 100 MHz POWER GAIN AND NOISE FIGURE TEST CIRCUIT

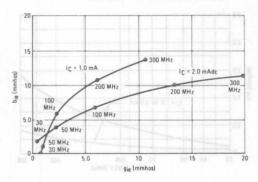


COMMON-EMITTER Y PARAMETERS (Polar Plots)

VCE = 10 Vdc, TA = 25°C

FIGURE 2 - INPUT ADMITTANCE





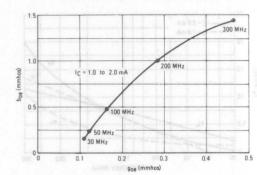


FIGURE 4 - FORWARD TRANSFER ADMITTANCE

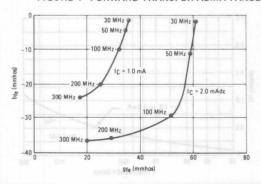
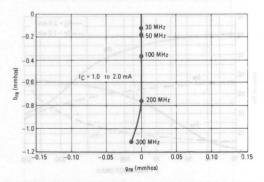
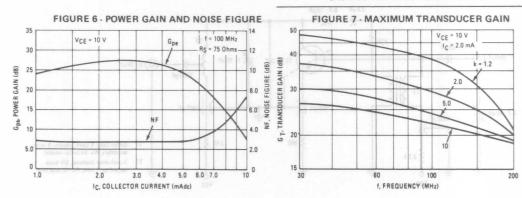


FIGURE 5 - REVERSE TRANSFER ADMITTANCE



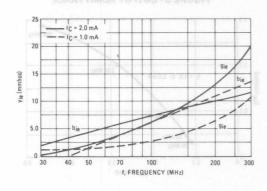


COMMON-EMITTER Y PARAMETERS vs FREQUENCY

VCE = 10 Vdc, TA = 25°C



FIGURE 9 - OUTPUT ADMITTANCE



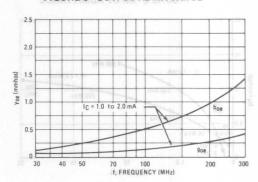
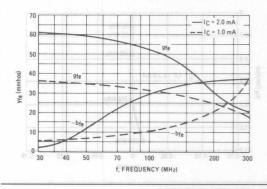
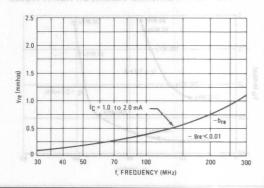


FIGURE 10 - FORWARD TRANSFER ADMITTANCE

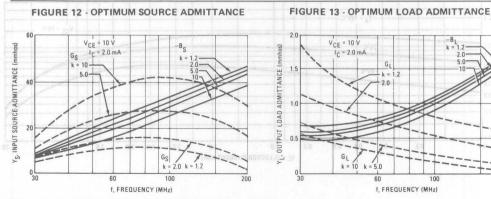
FIGURE 11 - REVERSE TRANSFER ADMITTANCE





enuice enuice

STABILITY FACTOR CURVES



When a potentially unstable device is operated without feedback, there is an infinite number of combinations of ource and load admittance associated with any given circuit stability factor (k). Equations have been developed for etermining the optimum source and load admittance for maximum gain. Figures 7, 12 and 13 provide a solution to he equations for the 2N5208.

NOISE FIGURE

FIGURE 14 - FREQUENCY EFFECTS

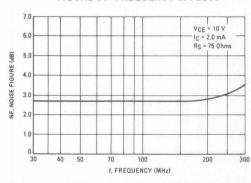


FIGURE 15 - SOURCE RESISTANCE EFFECTS

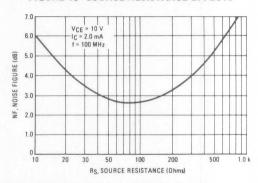


FIGURE 16 - CURRENT-GAIN - BANDWIDTH PRODUCT

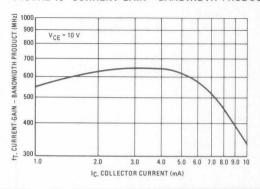
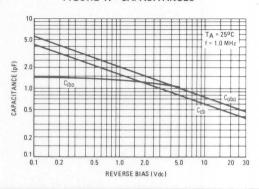
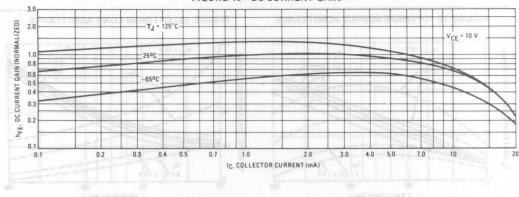


FIGURE 17 - CAPACITANCES



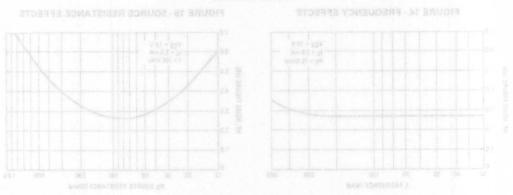
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 18 - DC CURRENT GAIN

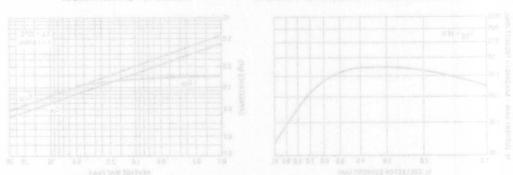


flow a potentially unvalve design is operated without fleedback, there is us reflects number of combinations of ourse and load as inforce, concluded with any plans recent making factor (a). Encodors need year designed fee there have for any country and shad admittance for maximum year. Expense 7, 75 and 12 provide a substant to

NOISE FIGURE



RE 16- CURRENT-GAIN -- BANDWIDTH PRODUCT FIGURE 17- CAPACITANCES



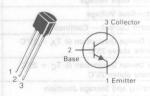
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	50	Vdc
Collector-Base Voltage	VCBO	50 50	Vdc
Emitter-Base Voltage	VEBO	4.5	Vdc
Collector Current — Continuous	Ic	50 50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	, bD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	20° 12

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	°C/W

2N5209 2N5210

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSA18 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Todaya		GITCHD, TV & 18	Dist.		
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	Vienicso		V(BR)CEO	50 agerloV nw	dont einer: ther Breakdo	Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mAdc, I _E = 0)	OSO(RB)V		V(BR)CBO	50 systlov	e Breakdown	Vdc
Collector Cutoff Current (VCB = 35 Vdc, IE = 0)	OSB(RS)V		ICBO	oftage	50	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)	osol .		IEBO	_	50	nAdc
ON CHARACTERISTICS					n = 31 mp.	M - 80
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc)	063	2N5209 2N5210	hFE	100 200	300 600	BE = 2.0 CHARAC
(I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)		2N5209 2N5210		150 250	(Sinia + ap v abA	Current C 1 = 4.0 m
0.1 (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)(2)		2N5209		150	iter Seturati Adc. <u>Ig</u> = 4	10.4 = 1
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	ina)38 ^V	2N5210	VCE(sat)	250	0.7	Vdc
Base-Emitter On Voltage (IC = 1.0 mAdc, VCE = 5.0 Vdc)	市		VBE(on)	10 Product = 1 obv 01	0.85	
SMALL-SIGNAL CHARACTERISTICS	de O			100	. Capacitano	ector-Basi
Current-Gain — Bandwidth Product (IC = 500 μ Adc, VCE = 5.0 Vdc, f =	20 MHz)		ff.	30	vec, <u>is. = 0,</u> Current Gair	MHz
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kH	z)	at printed circuit board.		10 V <u>ds</u> , 1 = ne device so		
Small-Signal Current Gain ($I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 0.0 \text{ MeV}$	1.0 kHz)	2N5209 2N5210	h _{fe}	150 250	600 900	1186 T 981
Noise Figure (I _C = 20 μ Adc, V _{CE} = 5.0 Vdc, R _S f = 10 Hz to 15.7 kHz)	= 22 k ohms,	2N5209 2N5210	NF	=	3.0 2.0	dB
$(I_C = 20 \mu Adc, V_{CE} = 5.0 \text{ Vdc}, R_S = 1.0 \text{ kHz})$	= 10 k ohms,	2N5209 2N5210		Ξ	4.0 3.0	

⁽¹⁾ $R_{\theta,JA}$ is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

2N5209 2N5210

MAXIMUM RATINGS

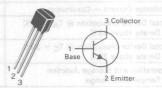
MAXIMOM INTINGO		
Symbol	Value	ga Unit
VCEO	15	0 Vdc
VCBO	aby 20	Vdc
VEBO	obA 2.0	Vdc
Ic	50	mAdc
PD	625 5.0	mW mW/°C
PD	1.5 12	Watt mW/°C
T _J , T _{stg}	-55 to +150	°C
	VCEO VCBO VEBO IC PD	VCEO 15 VCBO 20 VEBO 2.0 IC 50 PD 625 5.0 PD 1.5 12

THERMAL CHARACTERISTICS

		1000	200001
Characteristic	Symbol	Max	as Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	THE °C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	°C/W

2N5222

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS			sential/ gw	objection Regards	nil samelle
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)		V(BR)CEO	15	nAdc , I g = 0	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)		V _(BR) CBO	20	DAdo lle = (
Emitter-Base Breakdown Voltage $(I_E = 100 \mu Adc, I_C = 0)$		V _{(BR)EBO}	2.0	Voto , ig = 01	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)		СВО		100 0	nAdc
Emitter Cutoff Current (VBE = 2.0 Vdc, I _C = 0)	олезие	IEBO	I-MW 0.8	100	nAdc
ON CHARACTERISTICS					
DC Current Gain(2) (I _C = 4.0 mAdc, V _{CE} = 10 Vdc)	2NE209	hFE	20	150	0.1 = 31)
Collector-Emitter Saturation Voltage (I _C = 4.0 mAdc, I _B = 400 μAdc)	BOCEVIC.	VCE(sat)	5.0 Vdd)(2)	1.0	Vdc
Base-Emitter On Voltage (I _C = 4.0 mAdc, I _B = 400 μAdc)	2N5210	V _{BE(on)}	ecatioV no	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS			(abAm 6	AT = gl abAn	n (H = 51)
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)		fT	450 (aby 0.8	On Valtage * Agg, Vgg *	
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)		C _{cb}	renistrics h Product	1.0	
Small-Signal Current Gain (I _C = 4.0 mAdc, V _{CF} = 10 Vdc, f = 1.0 kHz)		hfe	20	300	No. 8 500

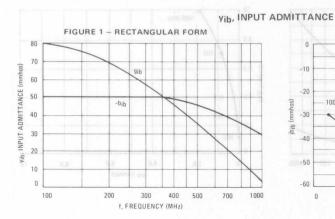
(1) R_{6JA} is measured with the device soldered into a typical printed circuit board.

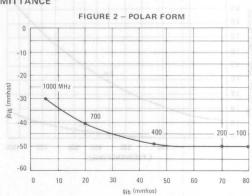
(2) Pulse Test: Pulse Width \approx 300 μ s, Duty Cycle \approx 2.0%.

- 44

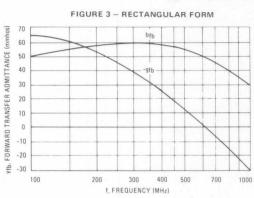
COMMON-BASE y PARAMETERS versus FREQUENCY

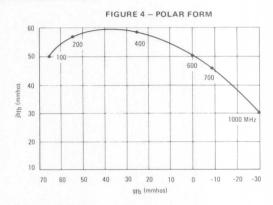
MAGNERA 109 - 8 3811013 (VCB = 10 Vdc, IC = 4.0 mAdc, TA = 25°C) 1130 MATOR - 5 3811013





Yfb, FORWARD TRANSFER ADMITTANCE

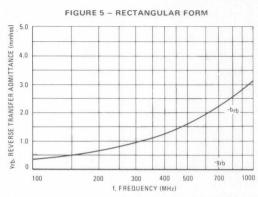


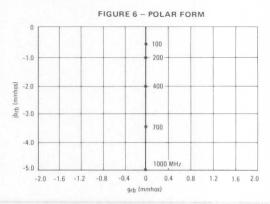


COMMON-BASE y PARAMETERS versus FREQUENCY

(VCB = 10 Vdc, IC = 4.0 mAdc, TA = 25°C)

yrb, REVERSE TRANSFER ADMITTANCE

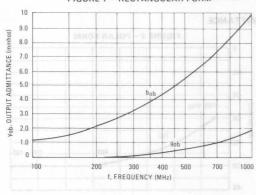


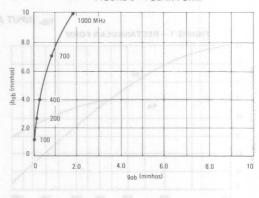


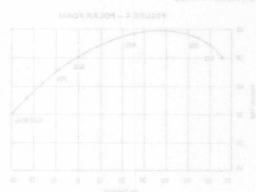
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

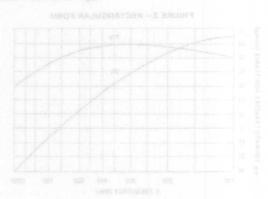
yob, OUTPUT ADMITTANCE

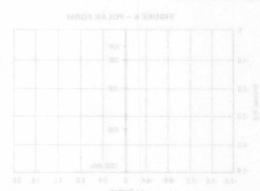
FIGURE 7 - RECTANGULAR FORM T SEAM DA = OLSEW OF = 80VI FIGURE 8 - POLAR FORM

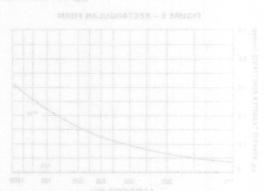












Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	abV 20	Vdc
Collector-Base Voltage	VCBO	9bW 25	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	Ic	DBAm 100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C °C

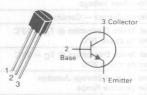
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	® °C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

2N5223

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N3903 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) Into assign Dress = (AT) 80178183T0A8A8D JAONTOS JE

tinU Max child Ch	aracteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				ROTTERSTICE	PAUL THO
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	ово(яв)У	V(BR)CEO	20	itter <u>Breakdo</u> nAdo, tg = 0)	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	овэмву	V(BR)CBO		ise <u>Grandovin</u> "Ado, Ig = 0	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	O83(86)V	V(BR)EBO	3.0	a Brazildown nAde, ic = 0	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)	lcao	ІСВО	-	100 host 100 host 100 host 100 host	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)	osai	IEBO		500	nAdc
ON CHARACTERISTICS			()	CTERISTICSIZ	ARAH3 MO
DC Current Gain (IC = 2.0 mAdc, VCE = 10 Vdc)	344	hFE	50		10 = 30 10 = 10
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	(TeatEDV	VCE(sat)	ro vete) on Vettage	0.7	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	VBE(sat)	VBE(sat)	(onage	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS			tobaim ui	= Bl opam	201 200
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f =	20 MHz)	fT	150	nari, chandi n — Bandwid	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MH	z) _{do} 0	C _{cb}	9:	4.0	pF d-101 ello
Small-Signal Current Gain (I _C = 2.0 mAdc, V _{CE} = 10 Vdc, f =	1.0 kHz)	h _{fe}	50	1600	Small Sign

Rating	Symbol	Value	JIS Unit
Collector-Emitter Voltage	VCEO	25 25	ydc Vdc
Collector-Base Voltage	VCBO	25	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	Ic	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	or 8°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	°C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

2N5226

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) with publishing 2'ds = ATI 20172/FRATOARAND LACIATORLIS

Sincia Kalai Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			ACTERISTICS	OFF CHAR
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, IB = 0)	V(BR)CEO		mitter B reakd mAdc, Ig =	
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	V(BR)CBO		see Brasidov - Ado, Ig =	
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	V(BR)EBO		a Bru—down pAdc. Ic =	
Collector Cutoff Current (V _{CB} = 15 Vdc, I _C = 0)	ІСВО	-	300	
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	IEBO	(0	500	
ON CHARACTERISTICS(2)			CTERISTICS	ON CHARA
DC Current Gain (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 50 mAdc, V _{CE} = 10 Vdc)	hFE	25	ggV—bAm	
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)	VCE(sat)		0.8	01 Vdc
Base-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)	V _{BE(sat)}		= 61.0 Am	
SMALL-SIGNAL CHARACTERISTICS		the President	himbooti	ne Statement of
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	2 fTN 02			MHz
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{cb}	46M 0. * = 1.0 MH:	= 20 V 0	pF
Small-Signal Current Gain (IC = 50 mAdc, VCE = 10 Vdc, f = 1.0 kHz)	(h _{fe} 0.1	30 07		10

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

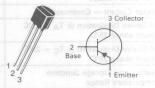
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	Ic	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N3905 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and seeing 3 da = 41 20172493704940 JACHTOS E

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					ACT BRISTICS	BANTO TRO
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	ge OBO(RB)V	2N5400	V(BR)CEO	30	nitter <u>B</u> raakd mAda, ig =	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	овојяві	CONTRACTOR	V _(BR) CBO	30 agentoV m	use Breakdow	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μ Adc, I _C = 0)		zivisnos	V(BR)EBO	3.0	31 -7 service	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)	OBB(RR)N		ІСВО	- OGENG V	100	nAdc
Emitter Cutoff Current (VBE = 2.0 Vdc, I _C = 0)	080,	2N5400 2N5401	IEBO	- (0	500	nAdc
ON CHARACTERISTICS		245490	(2)	0, TA = 180	90 Vdc, lg =	l = apVI
DC Current Gain (IC = 100 µAdc, V _{CE} = 10 Vdc) (IC = 2.0 mAdc, V _{CE} = 10 Vdc)	oeal oeal	ZNS401	hFE	30 50	100 <u>m</u> 0 No	6 = 80V 600 roman 7 = 88V
Collector-Emitter Saturation Voltag (I _C = 10 mAdc, I _B = 1.0 mAdc)	e sad		VCE(sat)	- 0	0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		2N5400 2N5401	VBE(sat)	= 5.0 Vec)	30 ^V 1.00Am	
SMALL-SIGNAL CHARACTERISTIC	s	nespier		folker in a	ended Mere	int and
Current-Gain — Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f		2N6461	fT	100	-	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 M	ИHz)	2N5400 2N5401	C _{cb}	(ab <u>V</u> 0.8 -	5.0	pF
Small-Signal Current Gain (IC = 2.0 mAdc, V_{CE} = 10 Vdc,	f = 1.0 kHz)		h _{fe}	50	1500	Briogosli s. (N = 10)

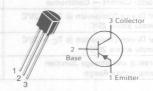
Rating	Symbol	2N5400	2N5401	Unit
Collector-Emitter Voltage	VCEO	120	150	Vdc
Collector-Base Voltage	VCBO	130	160	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic -	6	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	The section of the se	25 .0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	DISTANCES.	.5 2.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

2N5400 2N5401

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

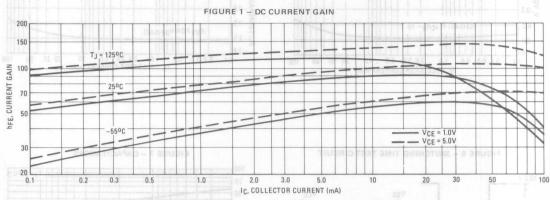
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

sint sould with C	haracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	(1) _{OSD(SE)} (1)	2N5400 2N5401	V(BR)CEO	120 150	tolsen@nantin = gl-obAm	0.1 = 31)
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	OBS(RB)V	2N5400 2N5401	V(BR)CBO	130 160	Add, 1g = 1 Add, 1g = 1 A Steakdown	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	OBOJ		V(BR)EBO	5.0	anoff Carrent	Vdc
Collector Cutoff Current (VCB = 100 Vdc, I _E = 0) (VCB = 120 Vdc, I _E = 0) (VCB = 100 Vdc, I _E = 0, T _A = 100 (VCB = 120 Vdc, I _E = 0, T _A = 100		2N5400 2N5401 2N5400 2N5401	ІСВО	<u> </u>	100 50 100 50	nAdc μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0)	240		IEBO	10 Vd a) - 10 Vda) -	AND THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NAMED IN COLUMN TWO I	nAdc
ON CHARACTERISTICS(1)				epsiloV no	mitter Saturat	:B-тоўзейю
DC Current Gain			hFE		mAdd, Ig =	(NC = 10)
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		2N5400 2N5401		30 see	r Sat ur ation	
(I _C = 10 mAdc, V _{CE} = 5.0 Vdc)		2N5400		40	180	
SHIM		2N5401	20 MHz)		240	
$(I_C = 50 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	Ccb	2N5400 2N5401	(5)	40	estiongs2 one	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)	PH		VCE(sat)	n 10 Vde. f	0.20 0.5	obV _{sign}
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)			VBE(sat)	_	1.0 1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 10 \text{ Vdc})$	= 100 Mhz)	2N5400 2N5401	fT	100 100	400 300	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 M	Hz)		C _{obo}	-	6.0	pF

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic	785 000	Symbol	Min	Max	Unit
Small-Signal Current Gain (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N5400 2N5401	h _{fe}	30 40	200	E.0
Noise Figure (I _C = 250 µAdc, V _{CE} = 5.0 Vdc, R _S = 1.0 kohm, f = 10 Hz to 15.7 kHz)	- 4.0 SEPARATE	NF	912 81101	8.0	dB

(1) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.



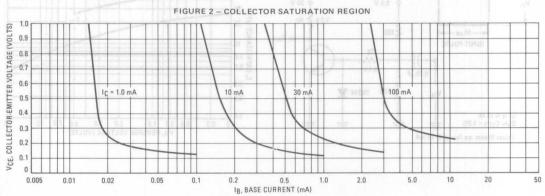
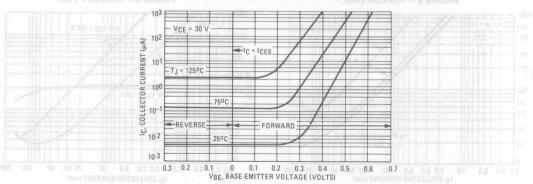
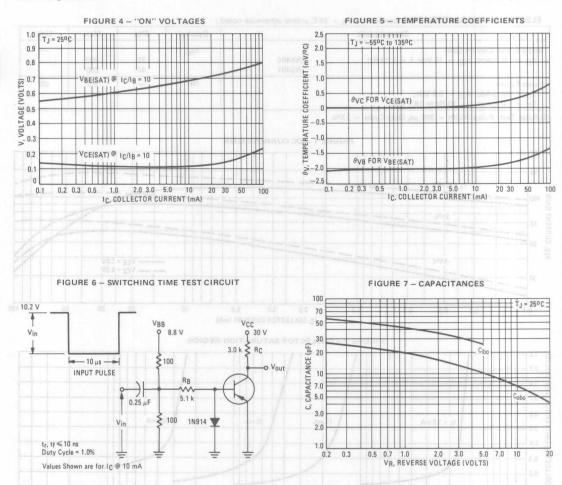
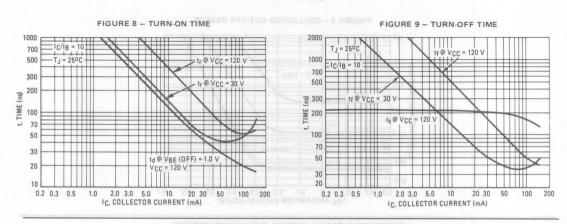


FIGURE 3 - COLLECTOR CUT-OFF REGION







MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

	T	T		
Rating	Symbol	2N5550	2N5551	Unit
Collector-Emitter Voltage	VCEO	140	160	Vdc
Collector-Base Voltage	VCBO	160	180	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current — Continuous	lc lc	600		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW/°C
Total Device Dissipation @ $T_C = 25^{\circ}C$ Derate above $25^{\circ}C$	PD	1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	357	°C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

2N5550 2N5551

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

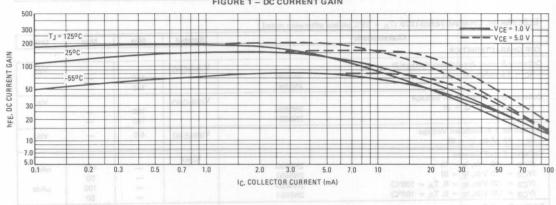
V 0.2 = 30V and and and Characteristic	des openion best best	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				1-1-18	
Collector-Emitter Breakdown Voltage(2) (IC = 1.0 mAdc, IB = 0)	2N5550 2N5551	V(BR)CEO	140 160	5488	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	2N5550 2N5551	V(BR)CBO	160 180		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)		V(BR)EBO	6.0		Vdc
Collector Cutoff Current (VCB = 100 Vdc, IE = 0) (VCB = 120 Vdc, IE = 0) (VCB = 100 Vdc, IE = 0, T _A = 100°C) (VCB = 120 Vdc, IE = 0, T _A = 100°C)	2N5550 2N5551 2N5550 2N5551	ICBO	8.0 — t.1	100 50 100 50	nAdc μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)		IEBO	-	50	nAdc
ON CHARACTERISTICS(2)					
DC Current Gain (IC = 1.0 mAdc, V_{CE} = 5.0 Vdc)	2N5550 2N5551	hFE	60 80	=	-
(I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	2N5550 2N5551	FIGURE 2	60 80	250 250	r is to the
(I _C = 50 mAdc, V _{CE} = 5.0 Vdc)	2N5550 2N5551	J	20 30	-	
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc) Am 86	Both Types	VCE(sat)		0.15	Vdc
(I _C = 50 mAdc, I _B = 5.0 mAdc)	2N5550 2N5551			0.25 0.20	
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	Both Types	V _{BE(sat)}		1.0	Vdc
(I _C = 50 mAdc, I _B = 5.0 mAdc)	2N5550 2N5551			1.2	

(2) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Max	Unit	
SMALL-SIGNAL CHARACTERISTICS	Sints	Pagaget	2015550	Jadenya		Rating	
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)				OBOV fT	100	300	a- MHz of
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	vae	901	0.8	Cobo	_	6.0	pF _{im3}
Input Capacitance $(V_{BE} = 0.5 \text{ Vdc}, I_C = 0, f = 1.0 \text{ MHz})$		2N5550 2N5551	925 925 9.0	Cibo	00 T _A = 2810	30	pF nived late? In stead
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	Matt 37\Win		1.6	nfe hfe	50	200	Total Device Decate at
Noise Figure $(I_C = 250 \ \mu Adc, V_{CE} = 5.0 \ Vdc, R_S = 1.0 \ kohm, f = 10 \ Hz \ to 15.7 \ kHz)$		2N5550 2N5551		NF	notion	10	

FIGURE 1 - DC CURRENT GAIN



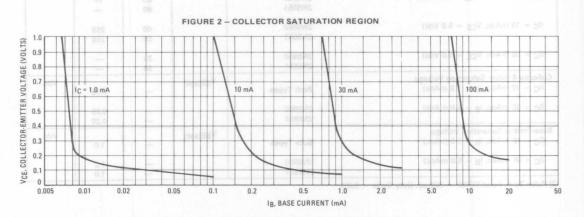


FIGURE 3 - COLLECTOR CUT-OFF REGION IT WO MAUT - # 384514

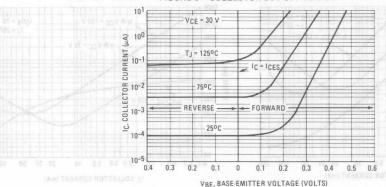


FIGURE 4 - "ON" VOLTAGES

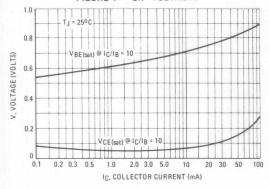


FIGURE 5 - TEMPERATURE COEFFICIENTS

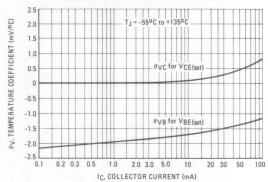


FIGURE 6 - SWITCHING TIME TEST CIRCUIT

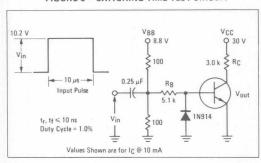
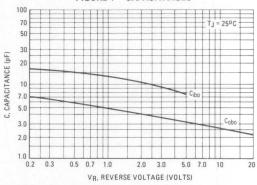
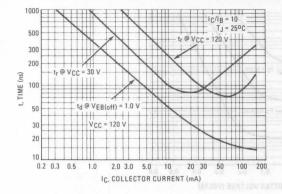
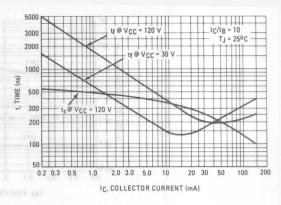


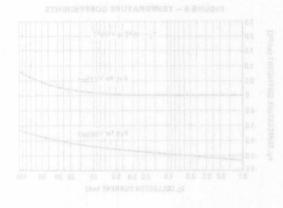
FIGURE 7 - CAPACITANCES

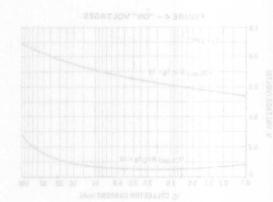


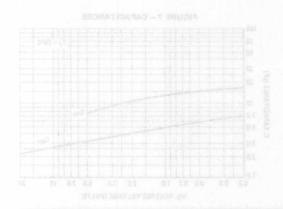
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

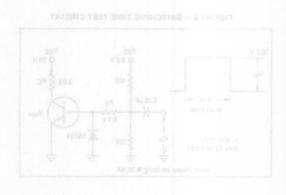












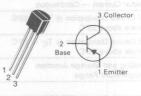
2N6427 CASE 29-04, STYLE

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Base Voltage	VCBO	15	Vdc
Emitter-Base Voltage	VEBO	4.5	Vdc
Collector Current — Continuous	Ic	50 000	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C
Lead Temperature	TL	260	°C

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

THE MUNICIPAL MUNICIPAL



SWITCHING TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			CTERISTICS	CEE CHARM
Collector-Emitter Breakdown Voltage (I _C = 3.0 mA)(1)	V(BR)CEO	spell 15 mag	odeet d iebir	Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 μA)	V(BR)CES	15	= gl_sbAn	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μA)	V(BR)CBO	15	se Br <u>e</u> akdoy	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μA)	V(BR)EBO	4.5	- 21.0000	Vdc
Collector Cutoff Current (V _{CB} = 8.0 Vdc)	ІСВО	Signal of the same	10	nA
Collector Cutoff Current (VCE = 8.0 Vdc) (VCE = 8.0 Vdc, T _A = 125°C)	ICES	=	10 5.0	nA μA
Emitter Cutoff Current (VBE = 4.5 Vdc)	IEBO	-	1.0	μΑ
ON CHARACTERISTICS		(1) Vdc, ig == 0	NCB - 3
DC Current Gain $ \begin{aligned} & (I_C = 1.0 \text{ mA, V}_{CE} = 0.5 \text{ Vdc})(1) \\ & (I_C = 10 \text{ mA, V}_{CE} = 0.3 \text{ Vdc})(1) \\ & (I_C = 50 \text{ mA, V}_{CE} = 1.0 \text{ Vdc})(1) \\ & (I_C = 10 \text{ mA, V}_{CE} = 0.3 \text{ Vdc, T}_{A} = -55^{\circ}\text{C}) \end{aligned} $	hFE	35 50 40 20	2120 V	Vas = 1
Collector-Emitter Saturation Voltage(1) (I _C = 1.0 mA, I _B = 0.1 mA) (I _C = 10 mA, I _B = 1.0 mA) (I _C = 50 mA, I _B = 5.0 mA)	VCE(sat)	(50 Vdc)	0.15 0.18 0.6	or Vdc
Base-Emitter Saturation Voltage(1) (I _C = 1.0 mA, I _B = 0.1 mA) (I _C = 10 mA, I _B = 1.0 mA) (I _C = 50 mA, I _B = 5.0 mA)	V _{BE(sat)}	0.75	0.8 0.95 1.5	Vdc
SMALL-SIGNAL CHARACTERISTICS		HOW VICE -	99 A GDWUI	ANC - 300
Collector-Base Capacitance (VCB = 5.0 Vdc, f = 140 kHz)	C _{cb}	ion Voltage	3.0	pF
Emitter-Base Capacitance (V _{BE} = 0.5 Vdc, f = 140 kHz)	C _{eb}	(0.5 m -1 do)	3.5	pFil
Small-Signal Current Gain (IC = 10 mA, VCE = 10 Vdc, f = 100 MHz)	h _{fe}	(ch 8.5) 2.0	mAde ig e	102 =
SWITCHING CHARACTERISTICS		fably 0.8	Adc. Vcs =	יוכ ב צם א
Storage Time (IC = 10 mA, IB1 \approx IB2 \approx 10 mA)	t _s	аоптанато	20	ns
Turn-On Time (I _C = 10 mA, I _B = 1.0 mA)	ton	10/0, 1 -1,	= 3(15/b)/ (ns
Turn-Off Time $(I_C = 10 \text{ mA}, I_{B1} = I_{B2} = 1.0 \text{ mA})$	toff (s)	M 0, F = 1,0 M	- 20	ns

(1) Pulse Conditions: Pulse Length = 300 μ s, Duty Cycle = 1.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	12	Vdc
Collector Current — Continuous	Ic	500	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 bV 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	+55 to +150	°C

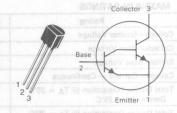
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	o ocw
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

2N6426 2N6427

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



DARLINGTON TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) To such a CTES AT 20172HETOARAND JACKSTOLIE

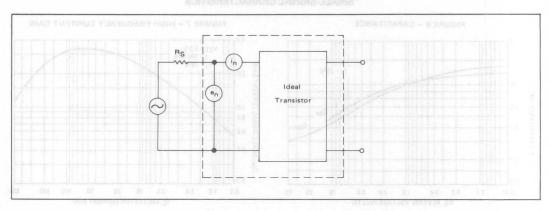
HnU xeM mild Chara	cteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					103	CHEST OF AN	HS 770
Collector-Emitter Breakdown Voltage(: (I _C = 10 mAdc, I _B = 0)	V(BR)CEC(S		V(BR)CEO	0 40 gan	akdown Vo akdown Vo	Emiller Bri	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	У/ввусво У		V(BR)CBO	40	dow in Volta	lgori l - ero il Indonnii aus	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	OBSCHOOL CO.		V(BR)EBO	(aby 0.8 =	ggVI the	Cutoff Cun	Vdc
Collector Cutoff Current (V _{CE} = 25 Vdc, I _B = 0)	830)		ICEO	= 8.0 Vde,	30A) TUR	1.0	μAdc
Collector Cutoff Current (VCB = 30 Vdc, I _E = 0)	083		ІСВО	(aby 8.8	= 38 <u>V</u>) In	50	nAdc
Emitter Cutoff Current (VBE = 10 Vdc, IC = 0)	397	g = 0.5 Vdol(1) = 0.3 Vdol(1)	= 10 mA, Vcg	ph) —	-	50	nAdc
ON CHARACTERISTICS	l me	(f)(abV 0.1 =		21)			
DC Current Gain(2) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	(tex)30V	2N6426 2N6427	hFE gl Am 0.r = gl Am 07 = gl Am 03 =	20,000	uetion Val	200,000	Collector
(I _C = 100 mAdc, V _{CE} = 5.0 Vdc)	(tex)38 ^V			30,000	lon Vo ltagel	300,000	Sace-En
$(I_C = 500 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		2N6426 2N6427		20,000 14,000	ARACTERIST	200,000 140,000	SNIAUI
Collector-Emitter Saturation Voltage (IC = 50 mAdc, IB = 0.5 mAdc) (IC = 500 mAdc, IB = 0.5 mAdc)	-do ²		VCE(sat)	=	0.71 0.9	1.2	Vdc
Base-Emitter Saturation Voltage (IC = 500 mAdc, IB = 0.5 mAdc)	hte		VBE(sat)	-	1.52	2.0	Vdc
Base-Emitter On Voltage (IC = 50 mAdc, VCE = 5.0 Vdc)			V _{BE(on)}	HIN OUT =	1.24	1.75	Vdc
SMALL-SIGNAL CHARACTERISTICS	e ^j					emi'	Eganolia e
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MH	z) noi		C _{obo}	(An	5.4	7.0	pF
Input Capacitance (VBE = 1.0 Vdc, I _C = 0, f = 1.0 MH	lz) ttol		C _{ibo}		10	15	pF

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
Input Impedance (IC = 10 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz)	2N6426 2N6427	hie	100 50	10 + + 0 15c	2000	kΩ
Small-Signal Current Gain (IC = 10 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz)	2N6426 2N6427	hfe	20,000		Augi egi	THE WILL
Current Gain — High Frequency (IC = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	2N6426 2N6427	h _{fe}	1.5 1.3	2.4 2.4		Elevano at
Output Admittance (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)		h _{oe}			1000	μmhos
Noise Figure (I _C = 1.0 mAdc, V_{CE} = 5.0 Vdc, R_S = 100 k Ω , f = 10 kHz to 15.7 kHz)	0081 008	NF 605 001	100 100	3.0	10	dB

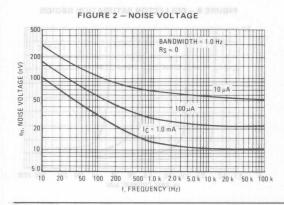
⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

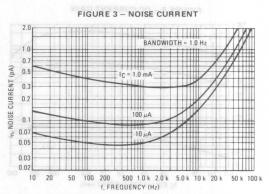
FIGURE 1 - TRANSISTOR NOISE MODEL



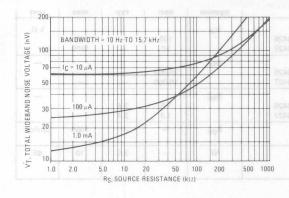
NOISE CHARACTERISTICS

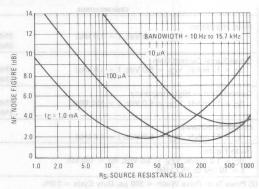
(V_{CE} = 5.0 Vdc, T_A = 25°C)



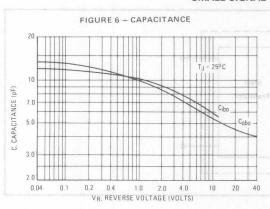


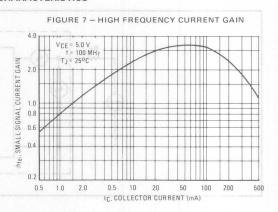
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

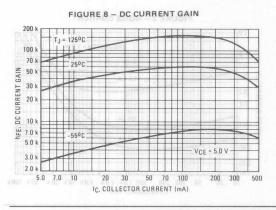


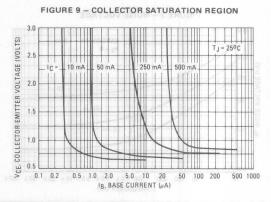


SMALL-SIGNAL CHARACTERISTICS









MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

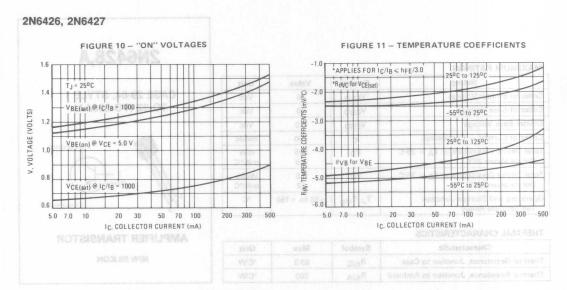
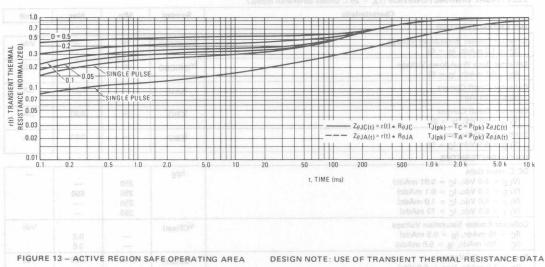
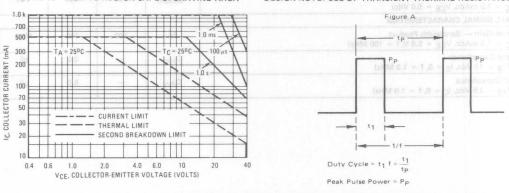


FIGURE 12 - THERMAL RESPONSE





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

INIAXIINIOINI NATIINGO			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	50	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

THE THAT OF A THOU			
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

2N6428,A

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				1.0
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V _(BR) CEO	50		Vdc
Collector-Base Breakdown Voltage (IC = 0.1 mAdc, IE = 0)	V(BR)CBO	60	20.0-	Vdc
Collector Cutoff Current (VCE = 30 Vdc)	ICEO	Simore brits:	0.025	μΑ
Collector Cutoff Current (VCB = 30 Vdc, I _E = 0)	ІСВО		0.01	μΑ
Emitter Cutoff Current (VEB = 5.0 Vdc, IC = 0)	I _{EBO}		0.01	μΑ
ON CHARACTERISTICS		01 20		100.0
DC Current Gain (V _{CE} = 5.0 Vdc, I _C = 0.01 mAdc) (V _{CE} = 5.0 Vdc, I _C = 0.1 mAdc) (V _{CE} = 5.0 Vdc, I _C = 1.0 mAdc) (V _{CE} = 5.0 Vdc, I _C = 10 mAdc)	hFE	250 250 250 250	 650 	_
Collector-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 0.5 mAdc) (I _C = 100 mAdc, I _B = 5.0 mAdc)	VCE(sat)		0.2 0.6	Vdc
Base-Emitter On Voltage HT TABLEMANT TO 32U STOM MDIESIO A 3RA (IC = 1.0 mAdc, VCE = 5.0 Vdc)	V _{BE} (on)	0.56	0.66	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (IC = 1.0 mAdc, V _{CE} = 5.0 V, f = 100 MHz)	fT	100	700	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo}		3.0	pF
nput Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	C _{ibo}	1	8.0	pF

(IC = 1.0 mAdc, VCE = 5.0 Vdc, f = 1.0 kHz)		250 300 390	hie	3.0	30	kΩ
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	SISY	0.8	h _{re}	2.0	20	X 10-4
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	blAm	oas	h _{fe}	200	800	Base Corre
Output Admittance	SCHIB	008	hoe	5.0	50	μmhos
(I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)		0.625	00	1	o Dissipation	sived 5to f

NOISE FIGURE/TOTAL NOISE VOLTAGE CHARACTERISTICS

TO-92 (TO-226AA)	NF VT Max (1)		to the same of	NF Ma	V _T × (2)	NF Ma:	V _T	U	nit
Noise Figure/Voltage (V _{CE} = 5.0 V, I _C = 0.1 mA, T _A = 25°C)	2N6428 2N6428A	3.0 2.0	18.1 16.2	6.0	5700 4600			dB dB	nV nV

(1) Rs = 10 k Ω , BW = 1.0 Hz, f = 100 Hz

(2) R_S = 50 k Ω , BW = 15.7 kHz, f = 10 Hz–10 kHz

(3) Rs = 500 Ω , BW = 1.0 Hz, f = 10 Hz

Rating	Symbol	2N6515	2N6516 2N6519	2N6517 2N6520	Unit
Collector-Emitter Voltage	VCEO	250	300	350	Vdc
Collector-Base Voltage	VCBO	250	300	350	Vdc
Emitter-Base Voltage 2N6515, 2N6516, 2N6517 2N6519, 2N6520	VEBO		6.0 5.0		
Base Current 008	IB		250		
Collector Current — Continuous	IC		500		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		0.625 5.0		
Operating and Storage Junction Temperature Range	TJ, T _{stg}	169 N	-55 to +150		
Lead Temperature ≥ 1/16" from case for 10 seconds	1.TL 0		260		

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	RAJA	200	°C/W

NPN 2N6515 thru 2N6517 PNP 2N6519 2N6520

TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Char	acteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) $(I_C = 1.0 \text{ mAdc}, I_B = 0)$	2N6515 2N6516, 2N6519 2N6517, 2N6520	V(BR)CEO	250 300 350		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	2N6515 2N6516, 2N6519 2N6517, 2N6520	V(BR)CBO	250 300 350	Ξ	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	2N6515, 2N6516, 2N6517 2N6519, 2N6520	V(BR)EBO	6.0 5.0	=	Vdc
Collector Cutoff Current (V _{CB} = 150 Vdc, I _E = 0) (V _{CB} = 200 Vdc, I _E = 0) (V _{CB} = 250 Vdc, I _E = 0)	2N6515 2N6516, 2N6519 2N6517, 2N6520	ICBO	Ξ	50 50 50	nAdc
Emitter Cutoff Current $(V_{EB} = 5.0 \text{ Vdc}, I_{C} = 0)$ $(V_{EB} = 4.0 \text{ Vdc}, I_{C} = 0)$	2N6515, 2N6516, 2N6517 2N6519, 2N6520	IEBO	=	50 50	nAdc
ON CHARACTERISTICS(1)			311111	1711	
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc)	2N6515 2N6516, 2N6519 2N6517, 2N6520	hFE	35 30 20	=	_
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N6515 2N6516, 2N6519 2N6517, 2N6520		50 45 30	=	
$(I_C = 30 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N6515 2N6516, 2N6519 2N6517, 2N6520		50 45 30	300 270 200	
(I _C = 50 mAdc, V_{CE} = 10 Vdc)	2N6515 2N6516, 2N6519 2N6517, 2N6520		45 40 20	220 200 200	
$(I_C = 100 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N6515 2N6516, 2N6519 2N6517, 2N6520		25 20 15	=	

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}C$ unless otherwise noted.)

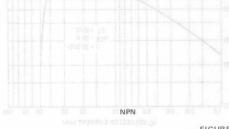
Characteristic		Symbol	Min	Max	Unit
Collector-Emitter Saturation Voltage		VCE(sat)			Vdc
(I _C = 10 mAdc, I _B = 1.0 mAdc)				0.30	
(I _C = 20 mAdc, I _B = 2.0 mAdc)		T = 128.90		0.35	
(I _C = 30 mAdc, I _B = 3.0 mAdc)		1 1000		0.50	la Inne
(I _C = 50 mAdc, I _B = 5.0 mAdc)				1.0	
Base-Emitter Saturation Voltage		VBE(sat)			Vdc
(I _C = 10 mAdc, I _B = 1.0 mAdc)				0.75	
$(I_C = 20 \text{ mAdc}, I_B = 2.0 \text{ mAdc})$				0.85	-
(I _C = 30 mAdc, I _B = 3.0 mAdc)	N/CLL		-	0.90	
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 10 Vdc)		V _{BE(on)}		2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					-

Current-Gain — Bandwidth Product(1) (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 20 MHz)		fT	40	200	MHz
Collector-Base Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MHz)	1 001 00	C _{cb}	o no reston o	6.0	pF
Emitter-Base Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	2N6515 thru 2N6517 2N6519, 2N6520	C _{eb}	= 1	80 100	pF

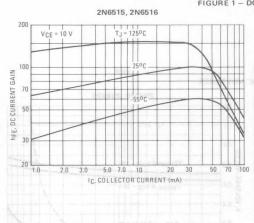
SWITCHING CHARACTERISTICS

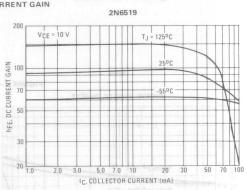
Turn-On Time (V _{CC} = 100 Vdc, V _{BE(off)} = 2.0 Vdc, I _C = 50 mAdc, I _{B1} = 10 mAdc)	ton	ETS, ZNISTS	200	ns
Turn-Off Time	toff		3.5	ns
$(V_{CC} = 100 \text{ Vdc}, I_{C} = 50 \text{ mAdc}, I_{B1} = I_{B2} = 10 \text{ mAdc})$				

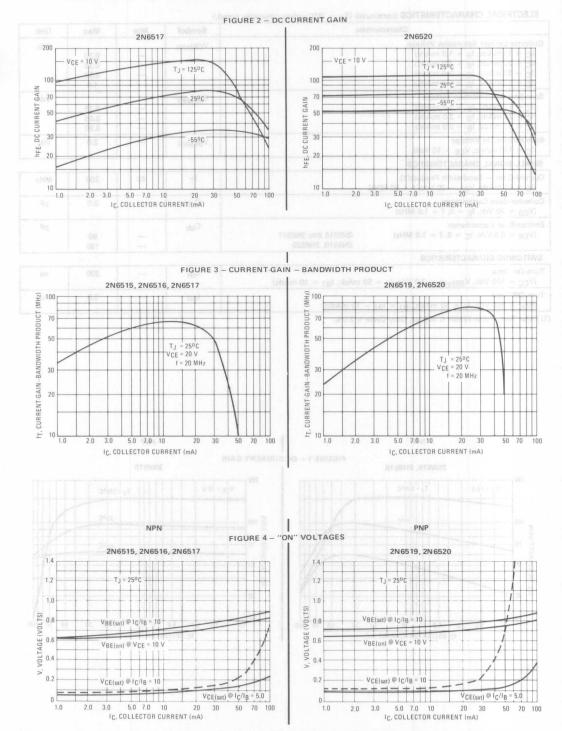
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.



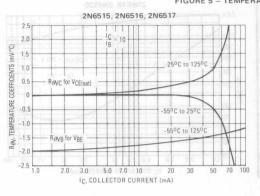








PIGURE 8 - M FIGURE 5 - TEMPERATURE COEFFICIENTS



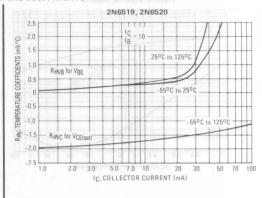
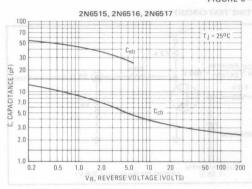
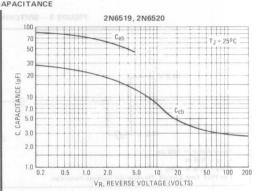
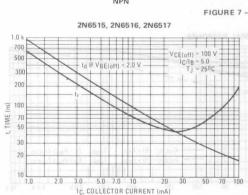


FIGURE 6 - CAPACITANCE

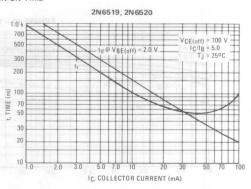




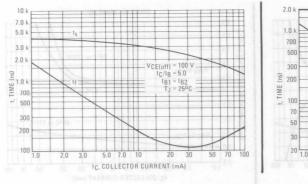
NPN



PNP FIGURE 7 - TURN-ON TIME



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



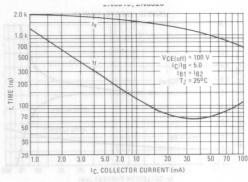
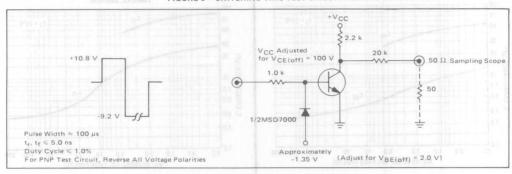
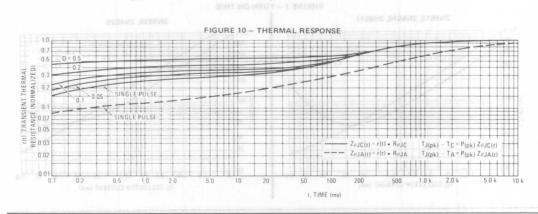


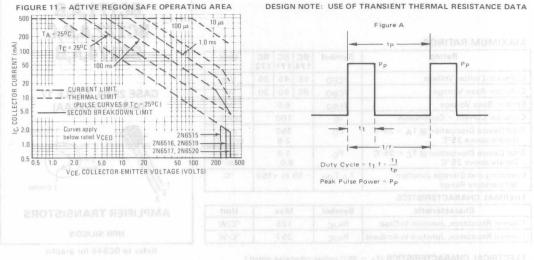
FIGURE 9 - SWITCHING TIME TEST CIRCUIT





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





NPN 2N6515 thru 2N6517, PNP 2N6519, 2N6520

	48.		

Rating	Symbol	BC 174	BC 171	BC 172	Unit
Collector-Emitter Voltage	VCEO	65	45	25	Vdc
Collector-Base Voltage	Vсво	80	50	30	Vdc
Emitter-Base Voltage	VEBO	79	6.0		Vdc
Collector Current - Continuous	IC	100			mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		350 2.8		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD May 3 yrod	1.0 8.0			Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55	ō to -	+150	°C

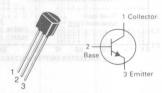
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	125	°C/W
Thermal Resistance, Junction to Ambient	RHJC	357	°C/W

BC171,A,B BC172,A,B,C BC174,A,B

SMESTS that ZMESTA, PAP ZMES

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

NPN SILICON

Refer to BC546 for graphs.

Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage		V(BR)CEO				V
$(I_C = 2.0 \text{ mA}, I_B = 0)$	BC174	(0.17020	65		_	
	BC171		45	_	_	
	BC172		25	_	_	
Emitter-Base Breakdown Voltage		V(BR)EBO			1.1	V
$(I_F = 100 \mu A, I_C = 0)$	BC171	(511/250	6.0	-	_	
	BC172		6.0			
	BC174		6.0	Ly iii —	_	
Collector Cutoff Current		ICES				nA
$(V_{CF} = 70 \text{ V}, V_{BF} = 0)$	BC174		_	0.2	15	
$(V_{CE} = 50 \text{ V}, V_{BE} = 0)$	BC171			0.2	15	
$(V_{CF} = 35 \text{ V}, V_{BF} = 0)$	BC172		_	0.2	15	
$(V_{CE} = 30 \text{ V}, V_{BE} = 0) \text{ T}_{\Delta} = 125^{\circ}\text{C}$			_	_	4.0	μΑ

ON	CHARA	CTERIS	TICS

ON CHARACTERISTICS		1				
DC Current Gain (I _C = 10 μ A, V _{CE} = 5.0 V)	BC171A/2A/4A BC171B/2B/4B BC172C	hFE	Ξ	90 150 270	Ξ	
$(I_C = 2.0 \text{ mA, } V_{CE} = 5.0 \text{ V})$	BC174 BC171 BC172 BC171A/2A/4A BC171B/2B/4B BC172C		120 120 120 120 120 180 380	 	450 800 800 220 460 800	
$(I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V})$	BC171A/2A/4A BC171B/2B/4B BC172C		Ε	120 180 300	=	
Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5.0 mA)		VCE(sat)	=	0.09 0.2	0.25 0.6	V
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA)		V _{BE(sat)}	-	0.7	- I	V
Base-Emitter On Voltage (I _C = 2.0 mA, V _{CE} = 5.0 V)		V _{BE(on)}	0.55		0.7	V

BC171,A,B, BC172,A,B,C, BC174,A,B

ELECTRICAL CHARACTERISTICS (continued) (TA = 25 °C unless otherwise noted)

Characteristic	Тур	e	Symbol	Min.	Тур.	Max.	Unit
DYNAMIC CHARACTERISTICS, SMALL SIGN.	AL CHARACT	TERISTICS					
Current-Gain Bandwidth Product (IC = 10 mA, VCE = 5 V, f = 100 MHz)	BC1 BC1 BC1	72 88 81	fT B lodmye	150 150 150	300 300 300	HEAR INC	MHz
Output Capacitance (VCB = 10 V, IC = 0, f = 1 MHz)		0 46 46	Cobo		1.7	4.5	notopF
Input Capacitance (VBE = 0.5 V, IC = 0, f = 1 MHz)	phAm	901	Cibo		10	Current - C	pF
Small-Signal Current Gain (IC = 2 mA, VCE = 5 V, f = 1 KHz)	BC171/1 BC171A	The state of the s	hfe	125 125	220	900 260	Crist Digital
	BC171B BC17		d9	240 450	330 600	500 900	Developed Developed
Noise Figure (IC = 0.2 mA, VCE = 5 V, RS = 2 KOhms,	BC1	21.2	NF		2	gna 10 en	series of
f = 1 KHz, Δf = 200 Hz)	BC1 BC1				2 2 3 3	10	AMA JE
AMPLIFIER TRANSISTORS	SING	X500	100 mys			/0818HL2	

MAXIMUM RATINGS Rating Symbol BC BC BC Unit 182 183 184 50 30 30 Vdc Collector-Emitter Voltage VCEO Collector-Base Voltage VCBO 60 45 45 Vdc Emitter-Base Voltage VEBO 6.0 Vdc mAdc 100 Collector Current - Continuous IC Total Device Dissipation @ TA = 25°C PD 350 mW Derate above 25°C 2.8 mW/°C 1.0 Watt Total Device Dissipation @ Tc = 25°C PD Derate above 25°C 8.0 mW/°C Operating and Storage Junction TJ, Tstg -55 to +150 °C Temperature Range THERMAL CHARACTERISTICS

Symbol

RHJC

RHJC

Max

125

357

Unit

°C/W

°C/W

1 Collector 2 Base 3 Emitter 3 AMPLIFIER TRANSISTORS NPN SILICON

BC183,A,B,C

CASE 29-04, STYLE 17

TO-92 (TO-226AA)

BC184,B,C

ELECTRICAL CHARACTERISTICS /T. - 25°C unless otherwise noted

Characteristic

Thermal Resistance, Junction to Ambient

Thermal Resistance, Junction to Case

Refer to BC237 for graphs.

Chara	acteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage ($I_C = 2.0 \text{ mA}$, $I_B = 0$)	ge BC182 BC183 BC184	V(BR)CEO	50 30 30	Ξ	=	V
Collector-Base Breakdown Voltage (I _C = 10 μ A, I _E = 0)	BC182 BC183 BC184	V(BR)CBO	60 45 45	Ξ	=	V
Emitter-Base Breakdown Voltage (IE = 100 μ A, IC = 0)		V(BR)EBO	6.0	_	_	V
Collector Cutoff Current (V _{CB} = 50 V, V _{BE} = 0) (V _{CB} = 30 V, V _{BE} = 0)	BC182 BC183 BC184	ІСВО	Ξ	0.2 0.2 0.2	15 15 15	nA
Emitter-Base Leakage Current $(V_{EB} = 4.0 \text{ V, I}_{C} = 0)$		I _{EBO}	_	-	15	nA
ON CHARACTERISTICS						
DC Current Gain (I _C = 10 μ A, V _{CE} = 5.0 V) (I _C = 2.0 mA, V _{CF} = 5.0 V)	BC182 BC183 BC184 BC182	hFE	40 40 100	Ξ	500	
	BC183 BC184		120 250	Ξ	800 800	
$(I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V})$	BC182 BC183 BC184		80 80 130	Ξ	=	
	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA})$ $I_C = 100 \text{ mA}, I_B = 5.0 \text{ mA})*$	VCE(sat)	=	0.07 0.2	0.25 0.6	V
Base-Emitter Saturation Voltage ($I_C = 100 \text{ mA}, I_B = 5.0 \text{ mA})*$	V _{BE(sat)}	-	_	1.2	V
	I _C = 100 µA, V _{CE} = 5.0 V) I _C = 2.0 mA, V _{CE} = 5.0 V) I _C = 100 mA, V _{CE} = 5.0 V)*	V _{BE(on)}	0.55	0.5 0.62 0.83	0.7	V

^{*}Pulse Test: Tp 300 s, Duty Cycle 2.0%.

DVNIABAIC CL	IARACTERISTICS	30.40	- 1			Symbol	Min	Тур	Max	Unit
		186	1.5	\$70×61 1.9	10 1 6	a 1 55.7 (-1)	Vo.2	T	Jane 1	T
	Bandwidth Produ		DOTOS		3 27	a ti		100	ghidsh	MHz
(IC = 0.5 m)	$^{1}A, V_{CE} = 3.0 V,$	T = 100 MHz)	BC182 BC183		08 0	EQ 50 3	AND THE STREET	100	onition Volta	-18/5/8/10
		BC184				W ±	140			
		BC182		5 45	5 00 00	150	200	agattov seq	ellectaria	
(IC = 10 m	A, VCE = 5.0 V, I	= 100 IVIH2)	BC182		0	8.0	150	240	agattov si	an princi
			BC184		0	11 1	150	280	100 - <u>16</u> 10m	Taphre II
	se Output Capacita V, I _C = 0, f = 1.0			MVm D°1/Wm	0.0	Cob	1 1 3	(Z = V) (8)	5.0	pF
Common Bas	se Input Capacitar	nce		VVBW.		C _{ib}	+ 2	8.0	e Crssiparion	pF
	$V, I_C = 0, f = 1.$	U IVITIZ)		00 10	01 t 1	9 46 912	ALT I	панопав	ric Orerage	garteman
	Current Gain	f - 10 kH=\	BC182			hfe	125		500	stegmil.
(IC = 2.0 II	$_{\text{nA, VCE}} = 5.0 \text{ V,}$	1 = 1.0 KHZ)	BC183				125	RISTICS	900	HERMAL
	ER TRANSIS		BC184		30.6	na foote	240	_oite	900	
				A, BC183A	81	100	125	eliontio Ce	260	H terms.
				B, BC183B, BC1	84B	16 30	240	nA of neito	500	Si kanas i
			BC1830	C, BC184C			450		900	
Noise Figure	a SUBDITEL GE				20.0	NF				dB
f = 30 Hz t	nA, V _{CE} = 5.0 V,		ms, BC184		nante			I GIRSTUR	AL CHAF	METOLL
		D OOL-				Type		2.0	4.0	
	$_{\rm c}^{\rm hA}$, $V_{\rm CE} = 5.0 \text{ V}$, $V_{\rm c}$, $V_{\rm c}$, $V_{\rm c}$	KS = 2.0 Kon	ms, BC182					2.0	10	FACHAR
1 - 1.0 KH2	., 1 – 200 112)		BC183				61	2.0	10	Prior serie
			BC184			80212	_	2.0	4.0	(10 2.0)
			96		N.	80214				

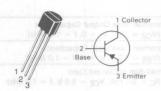
ship Rating	Symbol	BC 212	BC 213	BC 214	Unit
Collector-Emitter Voltage	VCEO	50	30	30	Vdc
Collector-Base Voltage	Vсво	60	45	45	Vdc
Emitter-Base Voltage	VEBO		5.0		Vdc
Collector Current - Continuous	Ic		100	mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0,0	350 2.8		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	10	1.0 8.0		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55	ō to -	150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	Rajc	125	°C/W
Thermal Resistance, Junction to Ambient	RHJC	357	°C/W

BC212,A,B BC213,A,B,C BC214,B,C

CASE 29-04, STYLE 17



AMPLIFIER TRANSISTORS

PNP SILICON

Refer to BC307 for graphs.

FLECTRICAL	CHARACTERISTICS	(T _Δ = 25°C unless otherwise noted)
ELECTRICAL	CHARACIERISTICS	$I \cap A = 25$ C unless otherwise noted)

Characteristic	Туре	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			kohms,	V. Hg = 2.0	A. Voge = 6.0	in 5.0 = g
Collector-Emitter Breakdown Voltage (IC = 2.0 mAdc, IB = 0)	BC212 BC213 BC214	V(BR)CEO	50 30 30	=		Vdc
Collector-Base Breakdown Voltage (IC = $10 \mu\text{A}$, IE = 0)	BC212 BC213 BC214	V(BR)CBO	60 45 45	_		Vdc
Emitter-Base Breakdown Voltage (IE = $10 \mu Adc$, IC = 0)	BC212 BC213 BC214	V(BR)EBO	5 5 5	<u>-</u>	==	Vdc
Collector-Emitter Leakage Current (VCB = 30 V)	BC212 BC213 BC214	ІСВО		=	15 15 15	nAdc
Emitter-Base Leakage Current (VEB = 4 V, I _C = 0)	BC212 BC213 BC214	IEBO	=		15 15 15	nAdc
N CHARACTERISTICS						
DC Current Gain (IC = 10 μ Adc, VCE = 5 Vdc)	BC212 BC213 BC214	hFE	40 40 100	=	=	
$(I_C = 2 \text{ mAdc}, V_{CE} = 5 \text{ Vdc})$	BC212 BC213 BC214		60 80 140	=	600	
$(I_C = 100 \text{ mAdc}, V_{CE} = 5 \text{ Vdc})^*$	BC212, BC214 BC213			120 140	_	

BC212,A,B, BC213,A,B,C, BC214,B,C

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted)

	Charac	teristic	2.00	Туре		Symbol	Min	Тур	Max	Unit
$(I_C = 10)$	mAdc, IB =	uration Vol = 0.5 mAdc = 5 mAdc))	-	u lan	VCE(sat)	odmyz 1	0.10 0.25	0.6	Vdc
		ion Voltage = 5 mAdc)		nie nie	es:	VBE(sat)	0230	1.00	1.4	Vdc
	ter on Volta	age = 5 Vdc)	CASI	de		VBE(on)	0.6	0.62	0.72	Vdc
DYNAMIC	CHARAC	TERISTICS								
Current-Gain Bandwidth Product (IC = 10 mAdc, VCE = 5 Vdc, f = 50 MHz)		t	BC212 BC214 BC213		0.1 0.1 0.8	69 09	280 320 360	Hasination (8) In 2550 Hasination (8) In 2570	Distributed of the control of the co	
		ut Capacita = 0, f = MH		0	e loa	Cob	yreT AT	noite	6.0	
Noise Figu		0,1 1011	8			NF		2017		+
Rs = 2 k	(ohms, f =	E = 5 Vdc, 30 Hz to 1 E = 5 Vdc,	5 KHz)	BC21	4	Max 125	Symbo Rejc	o en to Caso	2	
		1 KHz, f =		BC21 BC21		357	oueF_1	n to Ambien	10	
Small Sign			4 1/11	/bat	w salvas	hfe	8 ma 25	TERRETTE	L CHARAC	NET COTAG
(IC = 2 r	nAdc, VCE	= 5 Vdc, f	= 1 KHz)	BC21 BC21 BC21	3	aqyī	60 80 140	0(f)	Charactoria TERRISTICS	DE CHARAC
			45 25 25	BC212A, B BC212B, B BC214 BC213C, B	C213B, 1B	80239 80238 80238	100 200 200 350	egatiov nw	300 400 400 600	ins-mt.ollos ni 0 s = 7h
Pulse-test:	Tp 300 s,	Duty-cycle	2%.	OBE(RE)V		8G237 BC238 8C238		арено	A. Ic = Q)	apport -)
				8301						
		0.07								

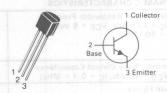
Rating 64.0	Symbol		BC 238	BC 239	Unit
Collector-Emitter Voltage	VCEO	45	25	25	Vdc
Collector-Emitter Voltage	VCES	50	30	30	Vdc
Emitter-Base Voltage	VEBO	6.0	5.0	5.0	Vdc
Collector Current - Continuous	IC	-	100	mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		350 2.8	mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		1.0	Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	- 5	5 to -	+150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	ReJC	125	°C/W
Thermal Resistance, Junction to Ambient	R _θ JC	357	°C/W

BC238,A,B,C BC239,B,C

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

NPN SILICON

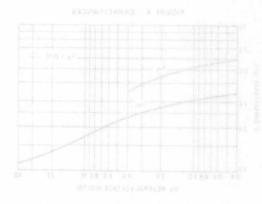
ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

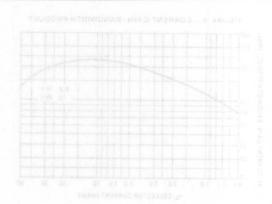
LELCTRICAL CHARACTERISTICS (TA - 25	CTRICAL CHARACTERISTICS (TA - 25°C unless otherwise noted)					
Characteristic	Type	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS	40.00	8021				
Collector-Emitter Breakdown Voltage (I _C = 2.0 mA, I _B = 0)	BC237 BC238 BC239	V(BR)CEO	45 25 25			V
Emitter-Base Breakdown Voltage (I _E = 100 μA, I _C = 0)	BC237 BC238 BC239	V(BR)EBO	6 5 5	Suty-cycle	,200E q	JaelVesi
Collector Cutoff Current (VCE = 30 V, VBE = 0) (VCE = 50 V, VBE = 0)	BC238 BC239 BC237	ICES		0.20 0.20 0.20	15 15 15	nA
(V _{CE} = 30 V, V _{BE} = 0) T _A = 125 °C (V _{CE} = 50 V, V _{BE} = 0) T _A = 125 °C	BC238 BC239 BC237			0.20 0.20 0.20	4 4 4	μА

ON CHARACTERISTICS

ON CHARACTERISTICS						
DC Current Gain (I _C = 10 μ A, V _{CE} = 5 V)	BC237A/238A BC237B/238B/239B BC237C/238C/239C	hFE		90 150 270		
(I _C = 2 mA, V _{CE} = 5 V)	BC237 BC238 BC239 BC237A/238A BC237B/238B/239B BC237C/238C/239C		120 120 120 120 120 200 380	170 290 500	800 800 800 220 460 800	
$(I_C = 100 \text{ mA, } V_{CE} = 5 \text{ V})$	BC237A/238A BC237B/238B/239B BC237C/238C/239C			120 180 300		
Collector-Emitter On Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5 mA)	BC237/BC238/BC239 BC237/BC239 BC238	VCE(sat)		0.07 0.20	0.20 0.60 0.8	V
Base-Emitter Saturation Voltage (IC = 10 mA, IB = 0.5 mA) (IC = 100 mA, IB = 5 mA)		VBE(sat)		0.60	0.83 1.05	V
Base-Emitter On Voltage (I _C = 100 µA, V _{CE} = 5 V) (I _C = 2 mA, V _{CE} = 5 V) (I _C = 100 mA, V _{CE} = 5 V)		VBE(on)	0.55	0.50 0.62 0.83	0.70	V

Characteristic	Туре	Symbol	Min.	Тур.	Max.	Unit
DYNAMIC CHARACTERISTICS		VIII TV				
Current-Gain Bandwidth Product (IC = 0.5 mA, VCE = 3 V, f = 100 MHz)	BC237 BC238 BC239	fT		100 120 140		MHz
(I _C = 10 mA, V _{CE} = 5 V, f = 100 MHz)	BC237 BC238 BC239		150 150 150	200 240 280		
Collector-Base Capacitance (V _{CB} = 10 V, I _C = 0, f = 1 MHz)		Cobo			4.50	pF
Emitter-Base Capacitance (VBE = 0.5 V, IC = 0, f = 1 MHz)		Cibo		8.0		pF
Noise Figure (I _C = 0.2 mA, V _{CE} = 5 V, R _S = 2 Kohms, f = 30 Hz to 15 KHz)	BC239	141	TABRAGO R	2	4	dB
(IC = 0.2 mA, VCE = 5 V, RS = 2 Kohms, $f = 1$ KHz, $\Delta f = 200$ Hz)	BC237 BC238 BC239			2 2 2	10 10 4	





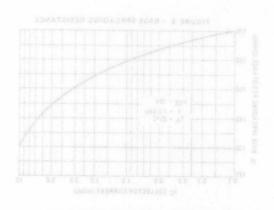
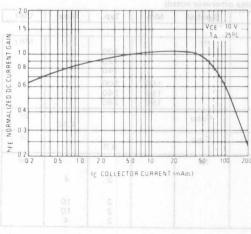


FIGURE 1 NORMALIZED DC CURRENT GAIN



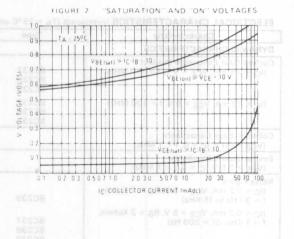
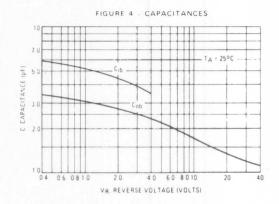
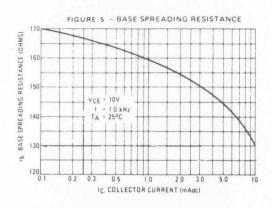


FIGURE 3 - CURRENT GAIN-BANDWIDTH PRODUCT BANDWIDTH PRODUCT (MH2) 300 200 VCE 10 V 100 80 60 CURRENT GAIN 20 30 IC. COLLECTOR CURRENT (mAdc)





sHM Rating	Symbol	BC 256	BC 251	BC 252	Unit
Collector-Emitter Voltage	VCEO	65	45	25	Vdc
Collector-Base Voltage	VCBO	80	50	30	Vdc
Emitter-Base Voltage	VEBO		5.0		Vdc
Collector Current - Continuous	1C		100	mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		350 2.8	mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0			Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55	ō to -	+150	°C

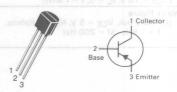
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _H JC	125	°C/W
Thermal Resistance, Junction to Ambient	RHJC	357	°C/W

BC251,A,B,C BC252,A,B,C BC256,A,B

211.A.B.C. BC252,A,B.C. BC256,A

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

PNP SILICON

Refer to BC556 for graphs.

Characteristic	Туре	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (IC = 2.0 mA, IB = 0)	BC256 BC251 BC252	V(BR)CEO	65 45 25			V
Emitter-Base Breakdown Voltage (IE = 100 μ A, IC = 0)	BC256 BC251 BC252	V(BR)EBO	5 5 5			V
Collector-Emitter Leakage Current (VCES = 40 V) (VCES = 20 V)	BC256 BC251 BC252	ICES		2 2 2	100 100 100	nA
(VCES = 20.V, TA = 125°C)	BC256 BC251 BC252				4 4 4	μА
ON CHARACTERISTICS						
DC Current Gain (I _C = 10 μ A, V _{CE} = 5 V)	BC251A/2A/6A BC251B/2B/6B	hFE		90 150		

DC Current Gain		hFE				
$(I_C = 10 \mu A, V_{CE} = 5 V)$	BC251A/2A/6A BC251B/2B/6B BC252C			90 150 270		
(I _C = 2 mA, V _{CE} = 5 V)	BC256 BC251 BC252 BC251A/2A/6A BC251B/2B/6B BC251C/BC252C		125 120 120 120 180 380	170 290 500	500 800 800 220 460 800	
$(I_C = 100 \text{ mA}, V_{CE} = 5 \text{ V})$	BC251A/2A/6A BC251B/2B/6B BC252C			120 180 300		
Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5 mA)		VCE(sat)		0.075 0.25	0.3 0.65	V
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5 mA)		VBE(sat)		0.70		V
Base-Emitter on Voltage (IC = 2 mA, VCE = 5 V)		VBE(on)	0.55	0.62	0.70	٧٠

	Chara	cteristic	701			Туре		Symbo	1	Min.	Тур.	Max.	Unit
DYNAMI	CCHARAC	TERISTICS	S		part of					,	100	OFFICE PROPERTY.	C MIYWI
$(I_{C} = 10)$	ain Bandw mA, VCE	= 5 V, f = 5	50 MHz)		0.00	BC256 BC251 BC252	8 28 28 8 48 28	fT 03	DV VC		280 320 360	tloV rein	MHz
Output Ca	apacitance	0, f = 1 MH	Hz)		ob		5.0	Cob	av av		6.0	pF	
Noise Fig (IC = 0.	V _{CB} = 10 V, I _C = 0, f = 1 MHz) ise Figure C = 0.2 mA, V _{CE} = 5 V, R _S = 2 Kohms, f = 1 KHz, Δf = 200 Hz)				35/1	BC256 BC251 BC252	350 2.8 1.0		9	25°C	2 2 2	10 10 10	dB careClists tregrate tred Device
	100	66			35/1	Vm o	8.0 85 to +15	932	UT			ove 2610 and Storage	Derate ab perating
	NSISTO												

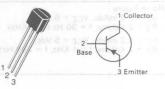
Rating OSC	Symbol	BC 307	BC 308	BC 309	Unit	
Collector-Emitter Voltage	VCEO	45	25	25	Vdc	
Collector-Base Voltage	VCBO	50	30	30	Vdc	
Emitter-Base Voltage	VEBO	5.0			Vdc	
Collector Current - Continuous	1C	100			mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 2.8			mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0		Watt mW/°C		
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		°C °C		

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	ReJC	125	°C/W
Thermal Resistance, Junction to Ambient	R _H JC	357	°C/W

BC309,A,B,C

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

Characteristic	Type	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS			1979			
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, I _B = 0)	BC307 BC308 BC309	V(BR)CEO	45 25 25	=	=	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	BC307 BC308 BC309	V(BR)EBO	5 5 5	Ξ		Vdc Vdc
Collector-Emitter Leakage Current (VCES = 50 V, VBE = 0) (VCES = 30 V, VBE = 0) (VCES = 50 V, VBE = 0) TA = 125 °C (VCES = 30 V, VBE = 0) TA = 125 °C	BC307 BC308 BC309 BC307 BC308 BC309	ICES		0.2 0.2 0.2 0.2 0.2 0.2	15 15 15 4.0 4.0 4.0	nA μA

ON CHARACTERISTICS

DC Current Gain (IC = 10 μ Adc, VCE = 5 Vdc)	BC307A/308A/309A BC307B/308B/309B BC307C/308C/309C	hFE	Ξ	90 150 270	=	
$(I_C = 2 \text{ mAdc}, V_{CE} = 5 \text{ Vdc})$	BC307 BC308 BC309 BC307A/308A/309A BC307B/308B/309B BC307C/308C/309C		120 120 120 120 120 200 420	170 290 500	800 800 800 220 460 800	
(I _C = 100 mAdc, V _{CE} = 5 Vdc)	BC307A/308A/309A BC307B/308B/309B BC307C/308C/309C		=	120 180 300		
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 0,5 mAdc) (IC = 10 mAdc, IB = see Note 1) (IC = 100 mAdc, IB = 5 mAdc)		VCE(sat)		0.10 0.30 0.25	0.30 0.60	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc) (I _C = 100 mAdc, I _B = 5 mAdc)		VBE(sat)	=	0.70 1.00		Vdc
Base-Emitter on Voltage (IC = 2 mAdc, VCE = 5 Vdc)		VBE(on)	0.55	0.62	0.70	Vdc

Note 1: I_C = 10 mAdc on the constant base current characteristic, which yields the point I_C = 11 mAdc, V_{CE} = 1 V

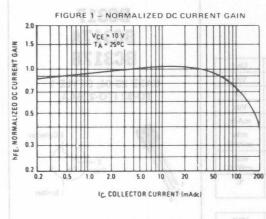
BC307,A,B,C, BC308,A,B,C, BC309,A,B,C

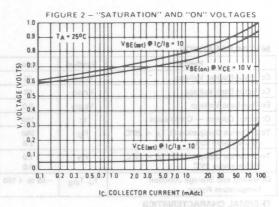
ELECTRICAL CHARACTERISTICS (continued) (TA = 25 °C unless otherwise noted)

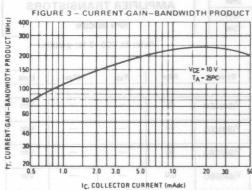
Characteristic	Туре		Symbol	Min.	Тур.	Max.	Unit		
DYNAMIC CHARACTERISTICS					801	I LAN INU	HXAM		
Current-Gain Bandwidth Product	and Ja	78 3	Symple		- Bitt	168	MHz		
(IC = 10 mAdc, VCE = 5 Vdc, f = 50 MHz)	BC307	1808/10	Ylana and a		280				
	BC308	5 25	VCEO LA	_	320	Whattima-	Collector		
CASE 29-04. STYLE 17	BC309	ne o	Vic ave	_	360	attent needs	Collantes		
Collector-Base Capacitance (VCB = 10 Vdc, IC = 0, f = 1 MHz)	dbV	0.8	C _{cbo}			6.0	PF		
Noise Figure	- DISAM	FIDA	NF		Bannana.	T INSTOU	dB		
(IC = 0.2 mAdc, VCE = 5 Vdc,					g4		AT 6) noi	ice Dissipat	veO leto?
RS = 2 Kohms, f = 30 Hz to 15 KHz)	BC309	2.8	1	_	2	25 4 vod	shrist		
(IC = 0.2 mAdc, VCF = 5 Vdc,		0.1	09		nT m nei	regissions	Intel Div		
RS = 2 Kohms, f = 1 KHz, f = 200 Hz)	BC307	0.8		_	2	1000	Deret .		
and the state of t	BC308 BC309	F 01 d8	T.J. Tstg		2 2	10	r Itshagti n ame T		
					TERISTICS	DARAHOJ	THERN A		

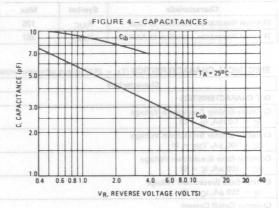
lots 1 10 = 10 mAde on the adversary base current observatio, which yields the point Ic = 11 mAdc, VcE = 1 V

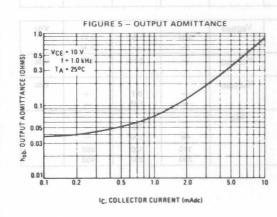
BC307,A,B,C, BC308,A,B,C, BC309,A,B,C

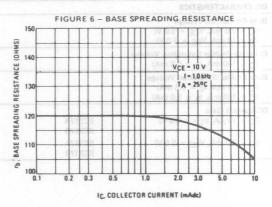












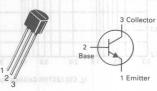
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	50	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	150	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JC$	357	°C/W

BC317A BC317B

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

NPN SILICON

Refer to BC549 for graphs.

Characteri	stic		Symbol -	Min	Тур	Max	Unit
OFF CHARACTERISTICS	1 4111	1 3					1007
Collector-Emitter Breakdown Voltage (I _C = 1.0 mA, I _B = 0)		200	V(BR)CEO	45			Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 μ A, V _{BE} = 0)			V(BR)CES	50		-	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ A, I _E = 0)		I	V _(BR) CBO	50			Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μ A, I _C = 0)	0.5 0.1 86 2.0 VB. REV		V(BR)EBO	6.0	LEECTON CUR	13.31	Vdc
Collector Cutoff Current (V _{CB} = 20 V, I _E = 0)			ІСВО	-	-	30	nAdo
ON CHARACTERISTICS							
Base-Emitter On Voltage (I _C = 2.0 mA, V _{CE} = 5.0 V) (I _C = 10 mA, V _{CE} = 5.0 V)	AB - B SRUDIR		VBE(on)	0.57	0.63	0.72 0.77	Vdc
Collector-Emitter Saturation Voltage (I _C = 100 mA, I _B = 5.0 mA)		OM 6	VCE(sat)	t	0.14	0.6	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5.0 mA)		GC1 - GC3	V _{BE} (sat)	1	0.7 0.85		Vdc
DC Current Gain (I _C = 10 μ A, V _{CE} = 5.0 V)	BC317A BC317B		hFE	40	90 150		
$(I_C = 2.0 \text{ mA, } V_{CE} = 5.0 \text{ V})$	BC317A BC317B			110 200	180 290	450 450	103

Characteristic			Symbol	Min	Тур	Max	Unit
SMALL-SIGNAL CHARACTERISTICS						POWITAG A	d many as
Spot Noise Figure (I _C = 200 µA, V _{CF} = 5.0 V,	nati	Value	NF	dray8	2.0	6.0	dB
$R_S = 2.0 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$, $BW = 200 \text{ Hz}$)		36		VOED		natioV rathm	
Output Capacitance	Vde	063	Cob	VE OV	2.5	4.0	F pF
$(V_{CB} = 10 \text{ V}, I_{E} = 0, f = 1.0 \text{ MHz})$	nov I	n a		VEDV		spelloV st	u Bark tarm
Input Capacitance ($V_{EB} = 0.5 \text{ V}$, $I_{C} = 0$, $f = 1.0 \text{ MHz}$)		180	Cib	1	11.5	коЭ — В леты	pF
Current-Gain Bandwidth Product (IC = 10 mA, VCE = 5.0 V)	O'Wan	98	fT	di I	280	3°dZ avoc	MHz
Voltage Feedback Ratio (I _C = 2.0 mA, V _{CE} = 5.0 V, f = 1.0 kHz)	3/9With	SI	h _{re}		2.0	1016 28.C	X10-4
Input Impedance (I _C = 2.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz)		0011100	hie	al er I	5.0	agneri erut	Kohms
Output Admittance (I _C = 2.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz)	tinU	368 070	hoe	Symb	20	Characteri Characteri	μmhos
Small-Signal Current Gain	W/O*	8 68	h _{fe}	Rapo	esion to Casa	raistance. Jun	pe and St
OL OL	317A W 3	200		125 240	220 330	260 500	

1			

Rating	Symbol	Unit		
Collector-Emitter Voltage	VCEO	45	Vdc	
Collector-Base Voltage	VCBO	50	Vdc	
Emitter-Base Voltage	VEBO	6.0	Vdc	
Collector Current — Continuous	Ic	150	mAdc	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C	

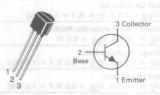
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JC}$	200	°C/W

BC320A BC320A BC320B

COTT, BOSTA, BOSTAS

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

NPN SILICON

Refer to BC559 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characte	ristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I _C = 1.0 mA, I _B = 0)		V(BR)CEO	45	-	-	Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 μ A, V _{BE} = 0) τ		V(BR)CES	50	-	-	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu A$, $I_E = 0$)		V(BR)CBO	50	_	-	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ A, IC = 0)		V(BR)EBO	6.0	_		Vdc
Collector Cutoff Current (V _{CB} = 20 V, I _E = 0)		ІСВО	-	-	30	nAdc
ON CHARACTERISTICS						
Base-Emitter On Voltage (I _C = 2.0 mA, V_{CE} = 5.0 V) (I _C = 10 mA, V_{CE} = 5.0 V)		VBE(on)	0.57	0.68	0.72 0.77	Vdc
Collector-Emitter Saturation Voltage (I _C = 100 mA, I _B = 5.0 mA)		VCE(sat)	-	0.35	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5.0 mA)		VBE(sat)	=	0.77 0.99		Vdc
DC Current Gain (I _C = 10 μ A, V _{CE} = 5.0 V)	BC320A BC320B	hFE	_ 40	50 100		
$(I_C = 2.0 \text{ mA, } V_{CE} = 5.0 \text{ V})$	BC320 BC320A BC320B		110 110 200	=	450 220 450	

BC320, BC320A, BC320B

Characteristic				Symbol	Min	Тур	Max	Unit
SMALL-SIGNAL CHARACTERISTICS								
Spot Noise Figure	BC320	TieU	BCX28	NF	4	2.0	6.0	dB
$(I_C = 200 \ \mu A, V_{CE} = 5.0 \ V,$				VOED 45			itter Voltage	mill-rulbs in
$R_S = 2.0 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$, $BW = 200 \text{ Hz}$)	1	Shill	30	08 080			opathoV as	affector I
Output Capacitance (VCB = 10 V, IE = 0, f = 1.0 MHz)				Cob	-	3.0	4.0	pF
Input Capacitance (VEB = 0.5 V, I _C = 0, f = 1.0 MHz)		Wes	808	Cib		16 1725 = AT 6	Dissipation	pF
Current-Gain Bandwidth Product		TriAshiri.	12.60	fT		250	2.07.94	MHz
$(I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V})$				gs.		04 TC = 25°C	and the second second	
Small-Signal Current Gain		O Manual	24	hfe			U 05 87	de araz-i
$(I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz})$	BC320			ee- ger.	125	<u>n</u> hitone	500	e Burreta
	BC320A				125	-	260	Meradu
	BC320B				240	257249	500	LAMBE

Characteris				
	8C327			

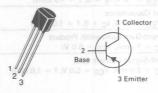
Rating	Symbol	BC327	BC328	Unit
Collector-Emitter Voltage	VCEO	45	25	Vdc
Collector-Base Voltage	VCBO	50	30	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	1c	800		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	3	.5	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JC$	200	°C/W

BC328,-16,-25,-40

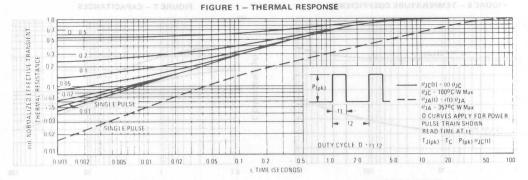
CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

PNP SILICON

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage $(I_C = 10 \text{ mA}, I_B = 0)$	BC327 BC328	V(BR)CEO	45 25	_	_	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 100 \mu A, I_E = 0$)	BC327 BC328	V(BR)CES	50 30	= :	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA, I _C = 0)		V _{(BR)EBO}	5.0	-	-	Vdc
Collector Cutoff Current $(V_{CB} = 30 \text{ V}, I_{E} = 0)$ $(V_{CB} = 20 \text{ V}, I_{E} = 0)$	BC327 BC328	ІСВО	=	_	100 100	nAdc
Collector Cutoff Current (V _{CE} = 45 V, V _{BE} = 0) (V _{CE} = 25 V, V _{BE} = 0)	BC327 BC328	ICES	=	_	100 100	nAdo
Emitter Cutoff Current (V _{EB} = 4.0 V, I _C = 0)		IEBO	-	-	100	nAdd
ON CHARACTERISTICS						
DC Current Gain (IC = 100 mA, V_{CE} = 1.0 V) (IC = 300 mA, V_{CE} = 1.0 V)	BC327/BC328 BC327-16/BC328-16 BC327-25/BC328-25 BC327-40/BC328-40	hFE	100 100 160 250 40	=	630 250 400 630	_
Base-Emitter On Voltage (I _C = 300 mA, V _{CE} = 1.0 V)		V _{BE(on)}	-	_	1.2	Vdc
Collector-Emitter Saturation Voltage (I _C = 500 mA, I _B = 50 mA)		V _{CE(sat)}		-	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Output Capacitance (V _{CB} = 10 V, I _E = 0, f = 1.0 MHz)		Cob	-	15		pF
Current-Gain Bandwidth Product (I _C = 10 mA, V _{CE} = 5.0 V)		fT	-	260	-	MHz





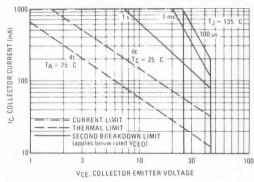


FIGURE 3 - DC CURRENT GAIN

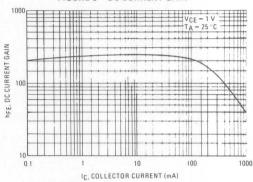


FIGURE 4 - SATURATION REGION

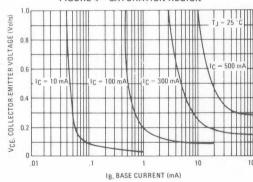
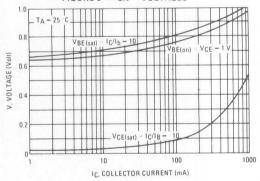
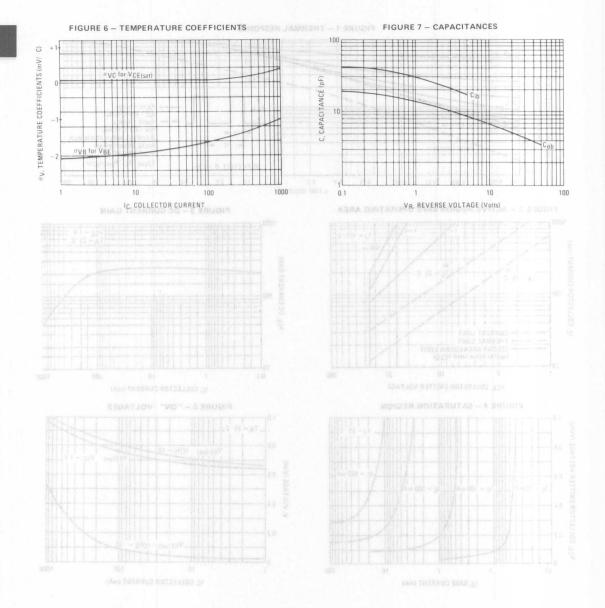


FIGURE 5 - "ON" VOLTAGES





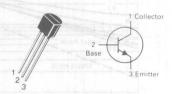
CDITTAN INDIVINA				
Rating	Symbol	BC337	BC338	Unit
Collector-Emitter Voltage	VCEO	45	25	Vdc
Collector-Base Voltage	VCBO	50	30	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	IC	800		mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD -	1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 to	-55 to +150	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	R_{θ} JC	200	°C/W

BC337,-16,-25,-40 BC338,-16,-25,-40

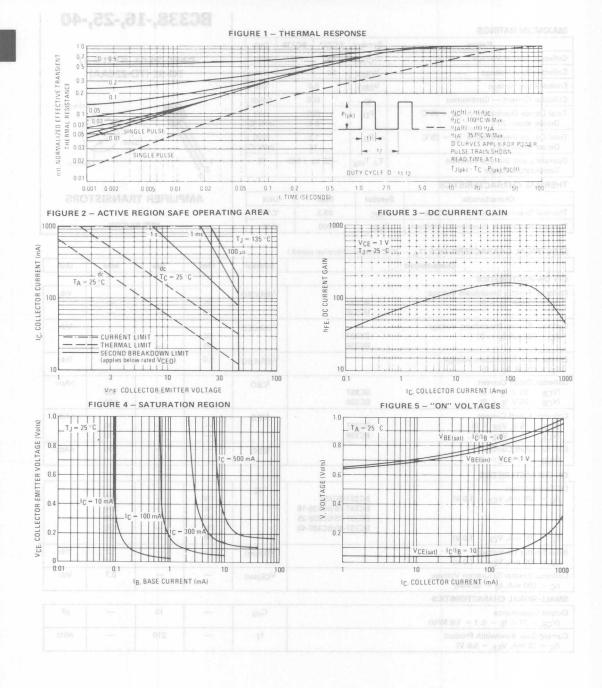
CASE 29-04, STYLE 17 TO-92 (TO-226AA)

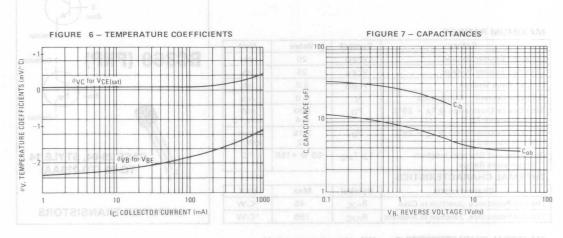


AMPLIFIER TRANSISTORS

NPN SILICON

Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS				N. E. O. L.	T Talk	
Collector-Emitter Breakdown Voltage (I _C = 10 mA, I _B = 0)	BC337 BC338	V(BR)CEO	45 25			Vdc
Collector-Emitter Breakdown Voltage (IC = 100 μ A, IE = 0)	BC337 BC338	V(BR)CES	50 30	Title Tribi	TWER M ED ON TAMPLET TE	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μ A, I _C = 0)	01	V(BR)EBO	5.0	(0.35 vals) v	injud 58 - 150	Vdc
Collector Cutoff Current $(V_{CB} = 30 \text{ V, } I_{E} = 0)$ $(V_{CB} = 20 \text{ V, } I_{E} = 0)$	BC337 BC338	ICBO		UI SATUR <u>I</u> RUTIER SAT UI RATION	100	nAdc
Collector Cutoff Current (V _{CE} = 45 V, V _{BE} = 0) (V _{CE} = 25 V, V _{BE} = 0)	BC337 BC338	ICES			100 100	nAdc
Emitter Cutoff Current (V _{EB} = 4.0 V, I _C = 0)		^I EBO			100	nAdc
ON CHARACTERISTICS						
DC Current Gain ($I_C = 100 \text{ mA}, V_{CE} = 1.0 \text{ V}$) ($I_C = 300 \text{ mA}, V_{CE} = 1.0 \text{ V}$)	BC337/BC338 BC337-16/BC338-16 BC337-25/BC338-25 BC337-40/BC338-40	hFE	100 100 160 250 60	- /= -	630 250 400 630	014
Base-Emitter On Voltage (I _C = 300 mA, V _{CE} = 1.0 V)		VBE(on)	Att	T LEFT	1.2	Vdc
Collector-Emitter Saturation Voltage (I _C = 500 mA, I _B = 50 mA)		VCE(sat)	(Am)	, sost current	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Output Capacitance (V _{CB} = 10 V, I _E = 0, f = 1.0 MHz)		C _{ob}	=	15	_	pF
Current-Gain Bandwidth Product (I _C = 10 mA, V _{CE} = 5.0 V)		fT	_	210	-	MHz





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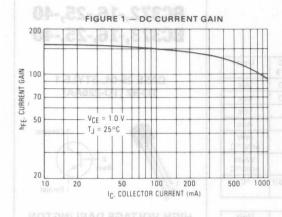
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Emitter Voltage	VCES	25	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current - Continuous	IC	1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	800 6.4	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.75 22	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

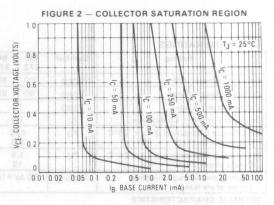
THERMAL CHARACTERISTICS

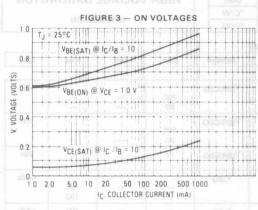
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	45	°C/W
Thermal Resistance, Junction to Ambient	RHJC	156	°C/W

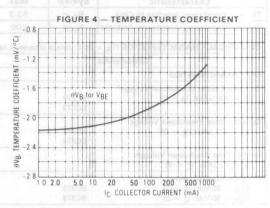


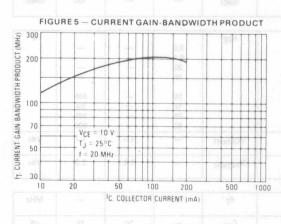
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 10 mA, I _B = 0)	V(BR)CEO	20	-		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu A, I_E = 0$)	V(BR)CBO	25	-	_	Vdc
Emitter-Base Breakdown Voltage $(I_E = 100 \mu A, I_C = 0)$	V(BR)EBO	5.0		_	Vdc
Collector Cutoff Current $(V_{CB} = 25 \text{ V}, I_E = 0)$ $(V_{CB} = 25 \text{ V}, I_E = 0, T_J = 150^{\circ}\text{C})$	СВО	=	=	10 1.0	μAdc mAdc
Emitter Cutoff Current (V _{EB} = 5.0 V, I _C = 0)	I _{EBO}	- 1	-	10	μAdc
ON CHARACTERISTICS					
DC Current Gain $(V_{CE} = 10 \text{ V}, I_{C} = 5.0 \text{ mA})$ $(V_{CE} = 1.0 \text{ V}, I_{C} = 0.5 \text{ A})$ $(V_{CE} = 1.0 \text{ V}, I_{C} = 1.0 \text{ A})$	hFE	50 85 60	Ē	 375 	_
Bandwidth Product ($I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 20 \text{ MHz}$)	fT	65	-		MHz
Collector-Emitter Saturation Voltage (I _C = 1.0 A, I _B = 100 mA)	VCE(sat)	-	-	0.5	V
Base-Emitter On Voltage (I _C = 1.0 A, V _{CE} = 1.0 V)	VBE(on)	-	-	1.0	V

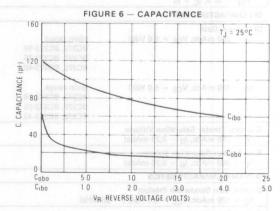












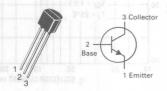
Rating	Symbol	BC 372	BC 373	Unit
Collector-Emitter Voltage	VCEO	100	80	Vdc
Collector-Base Voltage	Vсво	100	80	Vdc
Emitter-Base Voltage	VEBO	1	12	
Collector Current - Continuous	IC	1.0		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		on °Con

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BC373,-16,-25,-40

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH VOLTAGE DARLINGTON

BOATLOV MO NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

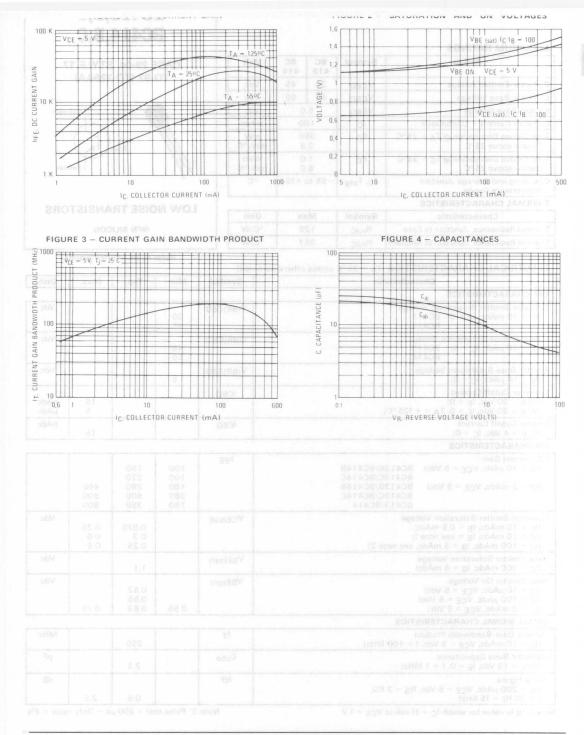
Characteristic	: III II II II II II II I	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				(Photography)	-	
Collector-Emitter Breakdown Voltage* (I _C = 100 μ Adc, I _B = 0)	BC372 BC373	V(BR)CES	100 80	VOE - 10 V	a molac.	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	BC372 BC373	V(BR)CBO	100 80			Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	4.5	V(BR)EBO	12	01 <u>8</u> 1 31 4	THE TOTAL	Vdc
Collector Cutoff Current (V _{CB} = 80 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0)	BC372 BC373	ІСВО	002002 I	01 08_ 05 01 03_00 01 0011600 0	100 100	nAdc
Emitter Cutoff Current (V _{BE} = 10 V, I _C = 0)		IEBO	-	-	100	nAdc

ON CHARACTERISTICS* DASAD - 8 38UDIS

DC Current Gain		hFE				K
(I _C = 250 mAdc, V _{CE} = 5.0 Vdc)	plain range		8.0			
	BC372, BC373-16		8.0			200
	BC372, BC373-25		20		-	
	BC372, BC373-40		40			-
$(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	plain range		10		600	
	BC372, BC373-16		10		60	1-3001
	BC372, BC373-25		25		160	-
	BC372, BC373-40		60		600	01
Collector-Emitter Saturation Voltage (I _C = 250 mAdc, I _B = 0.25 mAdc)		VCE(sat)		1.0	1.1	Vdc
Base-Emitter Saturation Voltage (I _C = 250 mAdc, I _B = 0.25 mAdc)		V _{BE(sat)}		1.4	2.0	Vdc

Current-Gain Bandwidth Product ($I_C = 100 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 20 \text{ MHz}$)	fT	100	200	_	MHz
Output Capacitance (V _{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C _{ob}		10	25	pF
Noise Figure (I _C = 1.0 mAdc, V_{CE} = 5.0 Vdc, R_{g} = 100 kohm, F = 1.0 kHz)	NF		2.0	-	dB

^{*}Pulse Test: Pulse Width = 300 µs, Duty Cycle 2.0%.



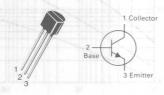
Rating	Symbol	BC 413	BC 414	Unit
Collector-Emitter Voltage	VCEO	30	45	Vdc
Collector-Base Voltage	Vсво	45	50	Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current - Continuous	IC	100		mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 2.8		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	125	°C/W
Thermal Resistance, Junction to Ambient	RHJC	357	°C/W

BC413,B,C BC414,B,C

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



LOW NOISE TRANSISTORS

NPN SILICON

Refer to BC549 for graphs.

Characteristic	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IB = 0) BC413 BC414	V(BR)CEO	30 45			Vdc
Collector-Base Breakdown Voltage (IC = 10 μAdc, IE = 0) BC413 BC414	V(BR)CBO	45 50			Vdc
Emitter-Base Breakdown Voltage (IE = 10 μAdc, IC = 0)	V(BR)EBO	5			Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0) (VCB = 30 Vdc, IE = 0, TA = + 125 °C)	ICBO		ar ar	15 5	nAdd μAdd
Emitter Cutoff Current (VEB = 4 Vdc, I _C = 0)	IEBO			15	nAdd
ON CHARACTERISTICS					
DC Current Gain $ (IC = 10 \ \mu Adc, \ VCE = 5 \ Vdc) \\ (IC = 2 \ mAdc, \ VCE = 5 \ Vd$	hFE	100 100 180 380 180	150 270 290 500 350	460 800 800	:
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 0.5 mAdc) (IC = 10 mAdc, IB = see note 1) (IC = 100 mAdc, IB = 5 mAdc, see note 2)	VCE(sat)		0.075 0.3 0.25	0.25 0.6 0.6	Vdc
Base-Emitter Saturation Voltage (IC = 100 mAdc, I _B = 5 mAdc)	VBE(sat)		1.1		Vdc
Base-Emitter On Voltage (IC = 10 µAdc, VCE = 5 Vdc) (IC = 100 µAdc, VCE = 5 Vdc) (IC = 2 mAdc, VCE = 5 Vdc)	VBE(on)	0.55	0.52 0.55 0.62	0.75	Vdc
SMALL SIGNAL CHARACTERISTICS					
Current-Gain-Bandwidth Product (IC = 10 mAdc, VCE = 5 Vdc, f = 100 MHz)	fŢ		250		MHz
Collector-Base Capacitance ($V_{CE} = 10 \text{ Vdc}$, $I_E = 0$, $f = 1 \text{ MHz}$)	C _{cbo}		2.5		pF
Noise Figure (I _C = 200 μAdc, V _{CE} = 5 Vdc, R _S = 2 KΩ, f = 30 Hz - 15 KHz)	NF		0.6	2.5	dB

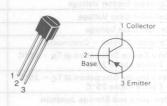
Rating	Symbol	BC 415	BC 416	Unit
Collector-Emitter Voltage	VCEO	35	45	Vdc
Collector-Base Voltage	Vсво	45	50	Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current - Continuous	IC	100		mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 2.8		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	125	°C/W
Thermal Resistance, Junction to Ambient	RH.JC	357	°C/W

BC415,B,C BC416,B,C

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



LOW NOISE TRANSISTORS

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

Characteristic	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS			gan	merman	1610 130
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IB = 0) BC415 BC416	V(BR)CEO	35 45	V nivebiles		Vdc
Collector-Base Breakdown Voltage (IC = 10 µAdc, IE = 0) BC415 BC416	V(BR)CBO	45 50	itaV nwobi	Sasa Braa	Vdc
Emitter-Base Breakdown Voltage (IE = 10 µAdc, IC = 0)	V(BR)EBO	5	10 =	31 ,AM, 00	Vdc
Collector Cutoff Current $(V_{CB} = 30 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 30 \text{ Vdc}, I_E = 0, T_A = +125 ^{\circ}\text{C})$	ІСВО	5	own Voltag = 0)	15 5	nAdo μAdo
Emitter Cutoff Current (VEB = 4 Vdc, IC = 0)	IEBO		######################################	15	nAdo
ON CHARACTERISTICS	Distant Distant		(0, =	OU Vale le	ACR -
DC Current Gain (IC = $10~\mu Adc$, $V_{CE} = 5~Vdc$) BC415B/BC416B BC415C/BC416C BC415B/BC416B BC415C/BC416C BC415/BC416C BC415/BC416C	BC4465-147-449 BC445-147-449 BC445-147-449	100 100 180 380 120	150 270 290 500 350	460 800 800	Cumer
Collector-Emitter Saturation Voltage (IC = 10 mAdc, Ig = 0.5 mAdc) (IC = 10 mAdc, IB - see note 1) (IC = 100 mAdc, IB - 5 mAdc, see note 2)	VCE(sat)		0.075 0.3 0.25	0.25 0.6	Vdc
Base-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 5 mAdc)	VBE(sat)		1.1		Vdc
Base-Emitter On Voltage ((C = 10 μAdc, VCE = 5 Vdc) (IC = 100 μAdc, VCE = 5 Vdc) (IC = 2 mAdc, VCE = 5 Vdc)	VBE(on)	0.55	The series are the	0.75	
SMALL SIGNAL CHARACTERISTICS				aridus IV	
Current-Gain-Bandwidth Product (IC = 10 mAdc, VCE = 5 Vdc, f = 100 MHz)	fT		250	O na. Ve	
Collector-Base Capacitance (VCE = 10 Vdc, IE = 0, f = 1 MHz)	Ccbo		2.5	CHARAC	pF
Noise Figure $(I_C = 200 \mu Adc, V_{CE} = 5 Vdc, R_S = 2 K\Omega, f = 30 Hz - 15 KHz)$	and the second second	100 = 100 a Dury Cu	0.5	V 20	dB

Note 1: IB is value for which IC = 11 mA at VCE = 1 V

Note 2: Pulse test = 300 μs - Duty cycle = 2%

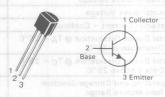
(AAOS Rating SE-OT	Symbol	BC 445	BC 447	BC 449	Unit
Collector-Emitter Voltage	VCEO	60	80	100	Vdc
Collector-Base Voltage	Vсво	60	80	100	Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc	
Collector Current - Continuous	IC	300		mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5		Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		91 99°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BC449,A,B

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

NPN SILICON

Refer to MPS8098 for graphs.

ELECTRICAL	CHARACTERISTICS (T	25°C unloss	athonying nated \

Characteristi	c locarrys		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					5381	PARACITERIS	0.440
Collector-Emitter Breakdown Voltage* (IC = 1.0 mAdc, IB = 0)	BC445 BC447 BC449		V(BR)CEO	60 80 100	= 0) BC&1 BC&1 BC&1 Rdown Volts	10 mAde is	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ A, IE = 0)	BC445 BC447 BC449		V(BR)CBO	60 80 100	BCA lown Voltage = 0)	Dase Brasic 10 pAdo 10	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	Uas		V(BR)EBO	5.0		- 30 Vdc, lg - 30 Vdc, ld	Vdc
Collector Cutoff Current $(V_{CB} = 40 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 60 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 80 \text{ Vdc}, I_E = 0)$	BC445 BC447 BC449		ІСВО	_	- (0)	100 100 100	nAdc
ON CHARACTERISTICS*	2.913		22153	BC415B/B	(SBV 8 = 3	aV sbA cG1	= hit
DC Current Gain (I _C = 2.0 mA, V _{CE} = 5.0 V)	BC445/447/ BC445A/44 BC447B/44	7A/449A	hFE A3	50	(abV_2) = 5	460 220 460	31)
$(I_C = 10 \text{ mA, } V_{CE} = 5.0 \text{ V})$ $(I_C = 100 \text{ mA, } V_{CE} = 5.0 \text{ V})$	BC445/447/ BC445A/44 BC447B/44: BC445/447/ BC445A/44 BC447B/44:	7449 7A/449A 9B 7A/449A		50 100 160 50 60 90	bAm 20 = sten 48		
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)	VBE(on)		VCE(sat)	-	0.1 gati	0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)			V _{BE} (sat)	-	0.85	2 mAde, Ve	Vdc
Base-Emitter On Voltage (I _C = 2.0 mA, V _{CE} = 5.0 V) (I _C = 100 mA, V _{CE} = 5.0 V)*	TI.		VBE(on)	0.55	050 <u>4</u> 41510 050 0.8	0.7 1.2	Vdc
DYNAMIC CHARACTERISTICS	eda-3			1	Societion	sgeu best in	il sello J
Current-Gain Bandwidth Product (I _C = 50 mAdc, V _{CE} = 5.0 Vdc, f = 100	MHz)		fT	100	250	etup	MHz

*Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle 2.0%.

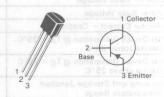
Rating	Symbol	BC 446	BC 448	BC 450	Unit
Collector-Emitter Voltage	VCEO	60	80	100	Vdc
Collector-Base Voltage	Vсво	60	80	100	Vdc
Emitter-Base Voltage	VEBO	bV	5.0	0	Vdc
Collector Current - Continuous	IC	Act	300	0	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	Wen Wwm	625 5.0	3.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	New NAm	1.5 12	8 0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55	5 to H	-150	Pag-C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W	
Thermal Resistance, Junction to Ambient	RH.IC	200	°C/W	

BC446,A,B BC448,A,B BC450,A,B

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

PNP SILICON

Refer to MPS8598 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) In CASS AN EXITABILITY AND AN EXITABILITY OF THE CONTROL OF T

Hou Kalvi Gyl Charact	eristic loamy2		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					STICS	ARACTERIS	13.01
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	BC446 BC448		V _{(BR)CEO}	60 80 100	renkdown v g = 0 <u>1.</u>	Brethmer B 1 0 mAde; I	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ A, IE = 0)	BC446		V(BR)CBO	60 80 100	10 = 3	obAu 001	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	a Casina;		V _{(BR)EBO}	5.0	70 =	of state to	Vdc
Collector Cutoff Current (VCB = 40 Vdc, I _E = 0) (VCB = 60 Vdc, I _E = 0) (VCB = 80 Vdc, I _F = 0)	BC446 BC448 BC450		ІСВО	10485 1048 2 1048 2	0 = g 0 = g 0 = g	100 100 100	nAdo
ON CHARACTERISTICS*	22/				7	ent Gein	1133 F
DC Current Gain (IC = 2.0 mA, V _{CE} = 5.0 V) (IC = 10 mA, V _{CE} = 5.0 V)	BC446/448 BC446A/44 BC446B/44 BC446/448 BC446A/44	BC446/448/450 BC446A/448A/450A BC446B/448B/450B BC446/448/450 BC446A/448A/450A BC446B/448B/450B		50 120 180 50 100 160	_	460 220 460 —	- 311
$(I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V})$	BC446/448 BC446A/44 BC446B/44	48A/450A		60	- lg <u>= 5</u> 0 m	500 <u>m</u> Ade 1 Ad <u>e</u> = 18	- 111 - 114
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)	hesigan		VCE(sat)	(ab)	0.125	0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)			V _{BE(sat)}	= 8	0.85	ARARD ON	Vdc
Base-Emitter On Voltage (I _C = 2.0 mA, V _{CE} = 5.0 V) (I _C = 100 mA, V _{CE} = 5.0 V)*	469		V _{BE} (on)	0.55	0.76	0.7 1.2	Vdc
DYNAMIC CHARACTERISTICS						macharar	3 may
Current-Gain-Bandwidth Product (I _C = 50 mAdc, V _{CE} = 5.0 Vdc, f	= 100 MHz)		fT	100	200	= 0.5-Vdc,	MHz

^{*}Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle 2.0%.

Rating	Symbol	BC 485	BC 487	BC 489	Unit
Collector-Emitter Voltage	VCEO	45	60	80	Vdc
Collector-Base Voltage	Vсво	45	60	80	Vdc
Emitter-Base Voltage	VEBO	HIN.	5.0	0	Vdc
Collector Current - Continuous	IC	i Am	Am 1.0		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625		mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 8 4/m 12		Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	- 58	ō to H	+150	+de°C

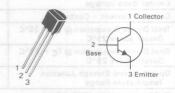
THERMAL CHARACTERISTICS

FLECTRICAL CHARACTERISTICS OF

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W	
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W	

BC485,A,B,L BC487,A,B,L BC489,A,B,L

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



HIGH CURRENT TRANSISTORS

NPN SILICON

Refer to MPSA05 for graphs.

Characteristic		Symbol	Min.	Тур.	Max.	Uni
OFF CHARACTERISTICS				FIGS	HACTERHS	40 110
Collector-Emitter Breakdown Voltage* (IC = 10 mAdc, IB = 0) BC485 BC487 BC489	OBDICEO	V(BR)CEO	45 60 80	ealsdown V	abAm e.r	= of
Collector-Base Breakdown Voltage $(IC=100~\mu Adc,~IE=0)$ BC485 BC487 BC489	Vianicso	V(BR)CBO	45 60 80		908 <u>908</u> 91 <u>Au</u> 001	Vdd
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	ова(яв)У	V(BR)EBO	5.0	towa_Volta	3801 <u>8</u> 1988	Vdd
Collector Cutoff Current VCB = 30 Vdc - IE = 0 BC485 VCB = 40 Vdc - IE = 0 BC487 VCB = 60 Vdc - IE = 0 BC489	oes)	ICBO 84808 84808	Ξ	-3nen -3nen -3nen -3nen	100 100 100	nAd select (Vcs
ON CHARACTERISTICS*		80450		10 = 3	gaby 08 =	(VCB
DC Current Gain (IC = 10 mAdc - V_{CE} = 2.0 Vdc) (IC = 100 mAdc - V_{CE} = 2.0 Vdc) 085 086 087 (IC = 1 Adc - V_{CE} = 5.0 Vdc)*	BC485/487/489 BC485L/487L/489L BC485A/487A/489A BC485B/487B/489B	HFE BANASADE NA NESADE NA NESADE AN NESADE AN NESADE AN NESADE AN NESADE	40 60 60 100 160 15	120 160 260	400 150 250 400	00 = 00 = 00
Collector Emitter Saturation Voltage (IC = 500 mAdc - IB = 50 mAdc) (IC = 1 Adc - IB = 100 mAdc)		VCE(sat)	=	0.2 0.3	0.50	Vd
Base Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1 Adc - I _B = 100 mAdc)*	(leat30A)	VBE(sat)	idage_ kde)	0.85 0.90	1.20	Vd
DYNAMIC CHARACTERISTICS	(162)38V		1	pskov hous	Mercal Period	3-988
Current-Gain-Bandwidth Product (IC = 50 mAdc, VCE = 2.0 Vdc, f = 100 I	MHz)	fT	_	200	VanQ_ratii	МН
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz)		Cob		7	V Am 007	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MHz)	71	Cib	- 10	50	Call-Band	pF

BC517,S

MAXIMUM RATINGS

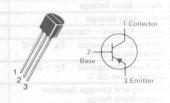
Rating	Symbol	BC 486	BC 488	BC 490	Unit
Collector-Emitter Voltage	VCEO	45	60	80	Vdc
Collector-Base Voltage	Vсво	45	60	80	Vdc
Emitter-Base Voltage	VEBO	4.0		Vdc	
Collector Current - Continuous	IC	Acti	1.0		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	Wm Nor	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	tevV	1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		y an°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BC486,A,B,L BC488,A,B,L BC490,A,B,L

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



HIGH CURRENT TRANSISTORS

PNP SILICON

Refer to MPSA55 for graphs.

Characteristic		Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS				900	ramarana	Main sais
Collector-Emitter Breakdown Voltage* (IC = 10 mAdc, IB = 0) BC486 BC488 BC490	Viserices Viserices	V(BR)CEO	45 60 80		Fruitte Bio Violatio V	Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0) BC486 BC488 BC490	OSS(AS) ^V	V(BR)CBO	45 60 80	(0 = 0). Sgenov dwo (0 = 0)	g "Ado, 1g ave dreekd 00 nAde, 1g	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μAdc, IC = 0)	9531	V(BR)EBO	4.0		20 VI	Vdc
Collector Cutoff Current VCB = 30 Vdc - IE = 0 BC486 VCB = 40 Vdc - IE = 0 BC488 VCB = 60 Vdc - IE = 0 BC490	083	СВО	=	tine 10 =	100 100 100	nAdc
ON CHARACTERISTICS*				(0 =	of laby 91	= 38V)
DC Current Gain (IC = 10 mAdc - V_{CE} = 2.0 Vdc) (IC = 100 mAdc - V_{CE} = 2.0 Vdc)	BC486/488/490 BC486L/488L/490L BC486A/488A/490A BC486B/488B/490B	SYFEOR	40 60 60 100 160	100 140 260	400 150	
Collector Emitter Saturation Voltage (I _C = 500 mAdc - I _B = 50 mAdc) (I _C = 1 Adc - I _B = 100 mAdc)		VCE(sat)	(c	0.25 0.50	0.50	Vdc
Base Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1 Adc - I _B = 100 mAdc)		VBE(sat)	(2) c, f = 100	0.90	1.20	Vdc
DYNAMIC CHARACTERISTICS		HE TEST OF STREET			180/1 # 18	ril - Ti
Current-Gain-Bandwidth Product (IC = 50 mAdc, VCE = 2.0 Vdc, f = 100 M	ЛНz)	fŢ	_	150	_	MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MHz)		Cob	_	9		pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MHz)		Cib	_	110	_	pF

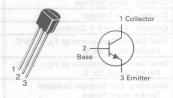
^{*}Pulse test - Pulse width = 300 µs - Duty Cycle 2%.

Rating	Symbol	BC517	Unit
Collector-Emitter Voltage	VCES	30	Vdc
Collector-Base Voltage	VCB	40	Vdc
Emitter-Base Voltage	VEB	10	Vdc
Collector Current - Continuous	IC	1.0	Adc
Total Power Dissipation TA = 25°C Derate above 25°C	PD	625 12	mW mW/°C
Total Power Dissipation T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	1 ggoC Bi

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	ROJA	200	°C/W
Thermal Resistance, Junction to Case	Rojc	83.3	°C/W

CASSE 29-04, STYLE 17 TO-92 (TO-226AA)



DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N6426 for graphs.

ELECTRICAL CHARACTERISTIC	acteristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						60111	SIND CHIEF	HO THU
Collector-Emitter Breakdown Volta (I _C = 2.0 mAdc, V _{BE} = 0)	ge	OaD(Ra)V		V _(BR) CES	30	8 70 = 8	glupb ra Gil	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	08	Viesiceo		V _(BR) CBO	40	8 <u> </u>	sant) excel-	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 nAdc, I _C = 0)	45			V _{(BR)EBO}	10	8 <u>(0 = 3</u> 8	Hana A. DOT	Vdc
Collector Cutoff Current (V _{CE} = 30 V) (V _{CE} = 20 V)	4.0	BC517 BC517S		ICES	_ =	lown Voltag = 0)	500 5.0	nA ₃
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)		0801		ІСВО	C488	8 0 = 3	100 og	nAdc
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)				IEBO	_08#3	8 _0 = 8	100 214 3 A F	nAdc
ON CHARACTERISTICS (1)		390					Tanish We	DC Cun
DC Current Gain (I _C = 20 mAdc, V _{CE} = 2.0 V) (I _C = 180 mAdc, V _{CE} = 1.2 V)	0.8	BC517S	024-881 1024-1034	hFE ABBACIS	30,000 33,000	VCE = 2.0 VCE_= 2.0	HabArn OO .	= 30
Collector-Emitter Saturation Voltage (IC = 100 mAdc, IB = 0.1 mAdc			ABBA4SBA ABBBMADB	VCE(sat)	-		1.0	Vdc
Base-Emitter On Voltage (IC = 10 mAdc, VCE = 5.0 Vdc)	61	VCE(sat)		V _{BE} (on)	996	lav e e Harabon Vol	1.4	Vdc
SMALL-SIGNAL CHARACTERISTIC	S				100	abAm 00.1	9) - 20Å	= 511
Current-Gain-Bandwidth Product ($I_C = 10 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$,	2) f = 100	MHz)		fT	- (a)	200	trov S ature 20 nAdout	MHz
1) Pulse Test Pulse Width ≤ 2.0%. 2) f _T = h _{fe} • f _{test}							Adc - 18	OYNAM

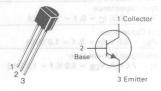
MAXIMUM RATINGS Rating Symbol BC BC BC Unit 546 547 548 Collector-Emitter Voltage **VCEO** 45 30 Vdc Collector-Base Voltage 80 50 30 Vdc **VCBO** Emitter-Base Voltage 6.0 Vdc **VEBO** Collector Current - Continuous 100 mAdc IC Total Device Dissipation @ TA = 25°C Derate above 25°C 625 mW PD mW/°C 5.0 Total Device Dissipation @ T_C = 25°C Derate above 25°C PD 1.5 Watt 12 mW/°C Operating and Storage Junction Temperature Range -55 to +150 °C TJ, Tstg

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

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CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characterist	tic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage $(I_C = 1.0 \text{ mA}, I_B = 0)$	BC546 BC547 BC548	V(BR)CEO	65 45 30	=	=	V
Collector-Base Breakdown Voltage (IC = 100 μ Adc)	BC546 BC547 BC548	V(BR)CBO	80 50 30	=	=	V
Emitter-Base Breakdown Voltage (IE = 10 μ A, IC = 0)	BC546 BC547 BC548	V(BR)EBO	6.0 6.0 6.0	=	=	V
Collector Cutoff Current (VCE = 70 V, VBE = 0) (VCE = 50 V, VBE = 0) (VCE = 35 V, VBE = 0) (VCE = 30 V, TA = 125°C)	BC546 BC547 BC548 BC546/547/548	ICES		0.2 0.2 0.2	15 15 15 4.0	nA μA
ON CHARACTERISTICS						
DC Current Gain (I _C = 10 μ A, V _{CE} = 5.0 V)	BC546A/547A/548A BC546B/547B/548B BC548C	hFE	Ξ	90 150 270	=	-
$(I_C = 2.0 \text{ mA, } V_{CE} = 5.0 \text{ V})$	BC546 BC547 BC548 BC546A/547A/548A BC546B/547B/548B BC547C/BC548C		110 110 110 110 200 420	180 290 520	450 800 800 220 450 800	
$(I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V})$	BC546A/547A/548A BC546B/547B/548B BC548C		=	120 180 300	=	
Collector-Emitter Saturation Voltage ($I_C = 10$ mA, $I_B = 0.5$ mA) ($I_C = 100$ mA, $I_B = 5.0$ mA) ($I_C = 10$ mA, $I_B = 5$ ee Note 1)		VCE(sat)	Ξ	0.09 0.2 0.3	0.25 0.6 0.6	V
Base-Emitter Saturation Voltage $(I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA})$		V _{BE(sat)}		0.7	_	V
Base-Emitter On Voltage (I _C = 2.0 mA, V _{CE} = 5.0 V) (I _C = 10 mA, V _{CE} = 5.0 V)		V _{BE(on)}	0.55	=	0.7 0.77	V

NOTE 1: IB is value for which $I_C = 11 \text{ mA}$ at $V_{CF} = 1.0 \text{ V}$.

Characteristic			Symbol	Min	Тур	Max	Unit
SMALL-SIGNAL CHARACTERISTICS	I Table	Low Low	The Lauren			I hardi	
Current-Gain Bandwidth Product		107 548	Theat				MHz
$(I_C = 10 \text{ mA, } V_{CE} = 5.0 \text{ V, f} = 100 \text{ MHz})$	BC546 BC547	08 80	laa pagv	150 150	300	leV textim3	
	BC548	GE 98	08 Gady	150	300	Base_Voltag	
Output Capacitance	Vds	0.0	Cobo		1.7	4.5	pF
$(V_{CB} = 10 \text{ V}, I_{C} = 0, f = 1.0 \text{ MHz})$	asiAm	00	21		augunitno	Current - C	Collector
Input Capacitance (VBE = 0.5 V, I _C = 0, f = 1.0 MHz)		25	C _{ibo}	_ 2*83	A10	ice Dissipat above 25°C	pF
Small-Signal Current Gain (IC = 2.0 mA, VCF = 5.0 V, f = 1.0 kHz)	BC546	6 E	h _{fe}	125	= 3T @ no	500	v rû <u>le</u> tal denoû
2 Emiliar	BC547/548 BC546A/547	A/548A	Be- gtaT L	125 125	220	900	
	BC546B/547 BC547C/548			240 450	330 600	500 900	o MRBHI
Noise Figure	A Auto	1	NF		9111111		dB
$(I_C = 0.2 \text{ mA}, V_{CE} = 5.0 \text{ V}, R_S = 2 \text{ kohms},$	BC546	8,6	50.98	_ 984	2.0	10	15/11/19/1
$f = 1.0 \text{ kHz}, \Delta f = 200 \text{ Hz})$	BC547	00	0148	- Daidm	2.0	10	emmsn
	BC548			_	2.0	10	

BC547/BC548

FIGURE 1 - NORMALIZED DC CURRENT GAIN

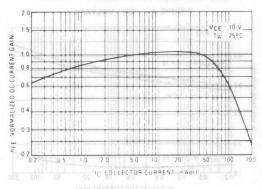


FIGURE 2 - "SATURATION" AND "ON" VOLTAGES

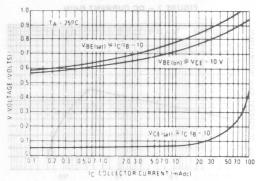


FIGURE 3 - COLLECTOR SATURATION REGION

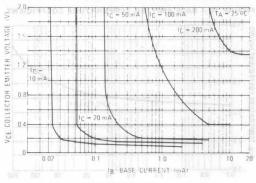


FIGURE 4 - BASE EMITTER TEMPERATURE COEFFICIENT

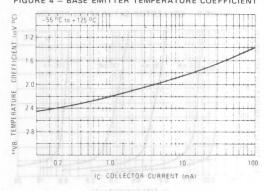


FIGURE 5 - CAPACITANCES

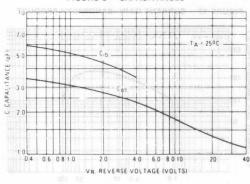
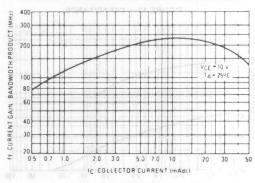
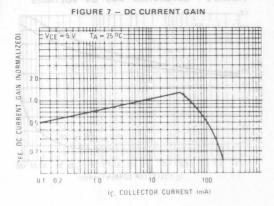
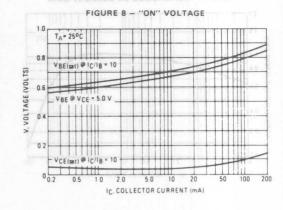
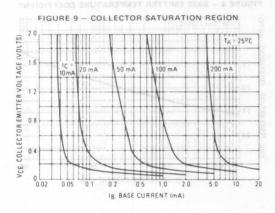


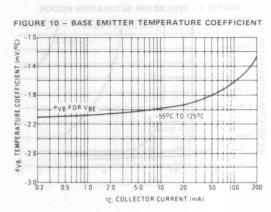
FIGURE 6 - CURRENT GAIN-BANDWIDTH PRODUCT

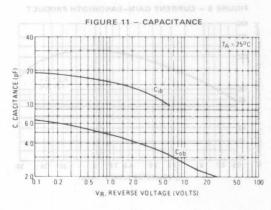


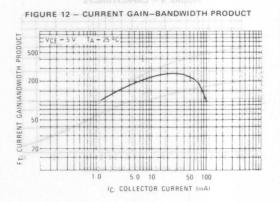












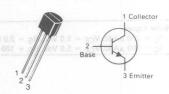
WAXIIWOW HATIIIGO	1.1200.00	1 00000000	HILL SEDII	U N 04
station of the state of the sta	Symbol	BC 549	BC 550	Unit
Collector-Emitter Voltage	VCEO	30	45	Vdc
Collector-Base Voltage 088 088	Vсво	30	50	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current - Continuous	IC	10	00	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		25	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		.5	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to	+150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _H JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BC549,A,B,C BC550,B,C

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



LOW NOISE TRANSISTORS

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

Characterist	tic	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS	-	() T + 1 1 1 1	EA			
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0) BC549 BC550	Isobi	V(BR)CEO	30 45			Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0) BC549 BC550	Transislez	V(BR)CBO	30 50			Vdc
Emitter-Base Breakdown Voltage (IE = 10 μAdc, IC = 0)		V(BR)EBO	5			Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0) (VCB = 30 Vdc, IE = 0, TA = + 125 °C)		ІСВО			15 5	nAdo μAdo
Emitter Cutoff Current (VEB = 4 Vdc, IC = 0)	IEBO			15	nAdd	
ON CHARACTERISTICS						
$(I_C = 2 \text{ mAdc}, V_{CE} = 5 \text{ Vdc})$ BC549 BC549	C/550C A B/550B C/550C	hFE	100 100 110 200 420 110	150 270 290 500	220 450 800 800	
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 0.5 mAdc) (IC = 10 mAdc, IB = see note 1) (IC = 100 mAdc, IB = 5 mAdc, see not	e 2)	VCE(sat)		0.075 0.3 0.25	0.25 0.6 0.6	Vdc
Base-Emitter Saturation Voltage (IC = 100 mAdc, IB = 5 mAdc)		VBE(sat)		1.1		Vdc
Base-Emitter On Voltage (IC = $10 \mu Adc$, $VCE = 5 Vdc$) (IC = $100 \mu Adc$, $VCE = 5 Vdc$) (IC = $100 \mu Adc$, $VCE = 5 Vdc$) (IC = $2 mAdc$, $VCE = 5 Vdc$)		VBE(on)	0.55	0.52 0.55 0.62	0.7	Vdc
SMALL SIGNAL CHARACTERISTICS						
Current-Gain-Bandwidth Product (IC = 10 mAdc, VCE = 5 Vdc, f = 100	MHz)	fŢ		250		MHz
Collector-Base Capacitance (VCE = 10 Vdc, IE = 0, f = 1 MHz)		C _{cbo}		2.5		pF

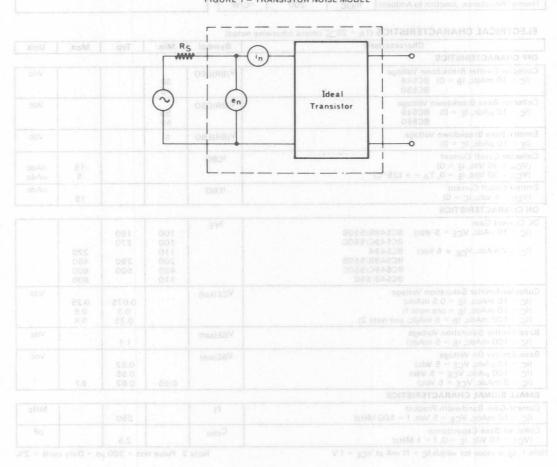
Note 1: IB is value for which IC = 11 mA at VCE = 1 V

Note 2: Pulse test = 300 µs - Duty cycle = 2%

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
mall-Signal Current Gain (I _C = 2.0 mAdc, V _{CE} = 5.0 V, f = 1.0 kHz)	000	h _{fe}				-
	BC549/BC550	050 030	125	egett	900	-10109110
	BC549B/BC550B	080 080	240	330	500	-retoslio
	BC549C/BC550C	8 003	450	600	900	auttleir-B
Noise Figure	nhAve Of			2uminitao3	~ tosmu	dB
$(I_C = 200 \ \mu Adc, V_{CF} = 5.0 \ Vdc, R_S = 2.0 \ k\Omega, f = 30 \ Hz-15 \ kHz)$		NF ₁	-	0.6	2.5	O Lote
$(I_C = 200 \mu\text{Adc}, V_{CF} = 5.0 \text{Vdc}, \text{Rs} = 100 \text{k}\Omega$		NF ₂	_0.0	ALM nod	10	TVE U 1630

FIGURE 1 - TRANSISTOR NOISE MODEL



BC549,A,B,C, BC550,B,C

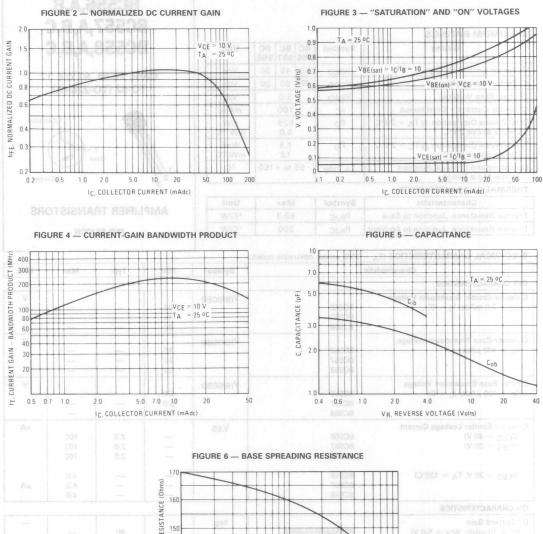


FIGURE 6 — BASE SPREADING RESISTANCE

PIGURE 6 — BASE SPREADING RESIST

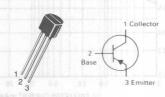
Rating	Symbol	BC 556	BC 557	BC 558	Unit
Collector-Emitter Voltage	VCEO	65	45	30	Vdc
Collector-Base Voltage	VCBO	80	50	30	Vdc
Emitter-Base Voltage	VEBO	in C	5.0		Vdc
Collector Current - Continuous	Ic	100			mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	In X	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	10	1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55	to -	150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BC556,A,B BC557,A,B,C BC558,A,B,C

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

PNP SILICON

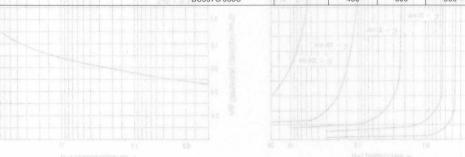
Characterist	ic de la	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage		V(BR)CEO				V
$(I_C = 2.0 \text{ mAdc}, I_B = 0)$	BC556		65			
	BC557		45			108
	BC558		30			08
Collector-Base Breakdown Voltage		V(BR)CBO				V
$(I_C = 100 \mu\text{Adc})$	BC556	(811)080	80	_		line.
	BC557		50	_	_	1 100
	BC558		30	111-11		1 192
Emitter-Base Breakdown Voltage		V(BR)EBO	4111			V
$(I_E = 100 \mu Adc, I_C = 0)$	BC556		5.0			
2.0 4.0 40 20	BC557		5.0	1.0 _ 0.0		. 30
	BC558		5.0	MOTO HADO G	_	
Collector-Emitter Leakage Current		ICES				nA
$(V_{CFS} = 40 \text{ V})$	BC556	020	_	2.0	100	
(VCES = 20 V)	BC557		_	2.0	100	
	BC558		-	2.0	100	
(V _{CES} = 20 V, T _A = 125°C)	BC556		97(1		4.0	
	BC557		-1 -1	_	4.0	μΑ
	BC558		L - 5	_	4.0	

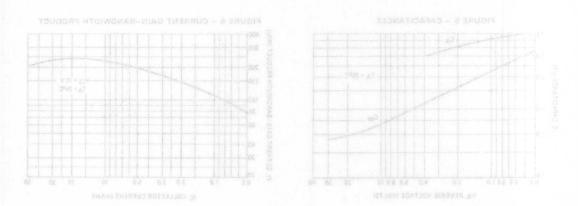
DC Current Gain hFE BC556A/557A/558A $(I_C = 10 \, \mu Adc, V_{CE} = 5.0 \, V)$ 90 BC556B/557B/558B 150 BC557C/558C 270 $(I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ V})$ BC556 120 500 BC557 120 800 BC558 120 800 BC556A/557A/558A 120 170 220 BC556B/557B/558B 180 290 460 BC557C/558C 420 500 800 $(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ V})$ BC556A/557A/558A 120 BC556B/557B/558B 180 BC557C/558C 300 Collector-Emitter Saturation Voltage VCE(sat) $(I_C = 10 \text{ mAdc}, I_B = 0.5 \text{ mAdc})$ 0.075 0.3 (I_C = 10 mAdc, I_B = see Note 1) (I_C = 100 mAdc, I_B = 5.0 mAdc) 0.3 0.6 0.25 0.65

NOTE 1: $I_C = 10$ mAdc on the constant base current characteristics, which yields the point $I_C = 11$ mAdc, $V_{CE} = 1.0$ V.

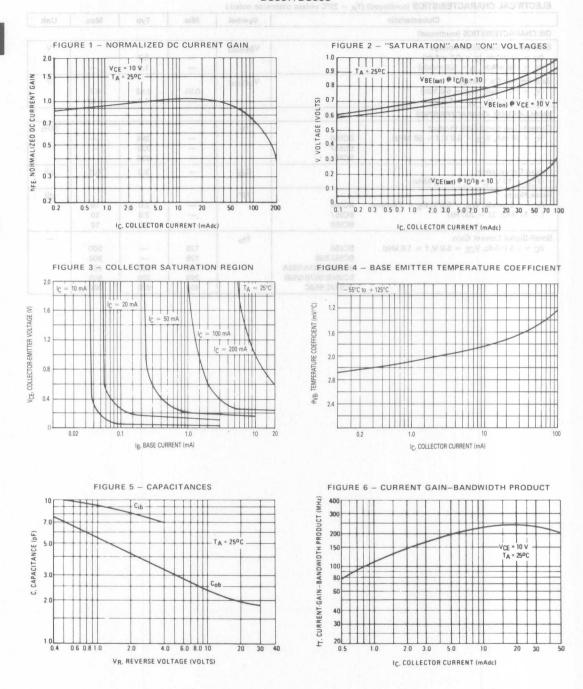
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

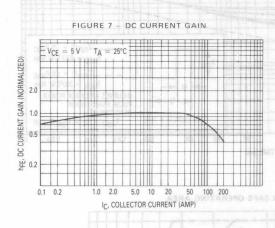
Characteristic		Symbol	Min	Тур	Max	Unit
ON CHARACTERISTICS (continued)						
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc) (I _C = 100 mAdc, I _B = 5.0 mAdc)	rauera	V _{BE(sat)}	DE CURREN	0.7 1.0 81 =	ои – 1 зас _о у <u>—</u> 1 ус	Tes
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	8.0 V 0 😨	V _{BE} (on)	0.55	0.62 0.7	0.7 0.82	V o
SMALL-SIGNAL CHARACTERISTICS	生量の夏					
Current-Gain Bandwidth Product (IC = 10 mA, V _{CE} = 5.0 V, f = 50 MHz)	BC556 BC557 BC558	ft		280 320 360	Ē	MHz
Output Capacitance (V _{CB} = 10 V, I _C = 0, f = 1.0 MHz)	0.2	Cob	-	3.0	6.0	pF
Noise Figure (IC = 0.2 mAdc, VCE = 5.0 V, RS = 2 kohms, f = 1.0 kHz, Δf = 200 Hz)	BC556 BC557 BC558	NF DE	OS OF OR OTHER DESIGNATION AND OTHER DESIGNA	2.0 2.0 2.0	10 10 10	dB
Small-Signal Current Gain (IC = 2.0 mAdc, V _{CE} = 5.0 V, f = 1.0 kHz)	BC556 BC557/558 BC556A/557A/558A BC556B/557B/558B	h _{fe}	125 125 125 125 240		500 900 260 500	- ner
	BC557C/558C		450	600	900	

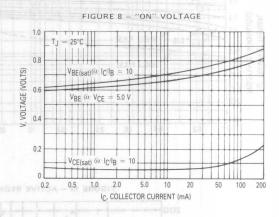


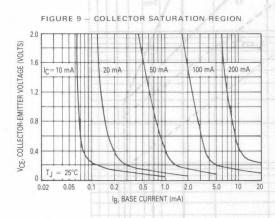


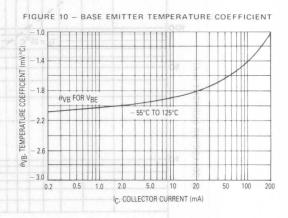
BC557/BC558

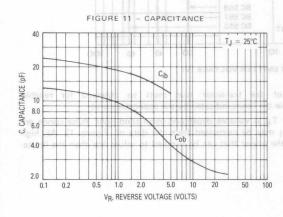












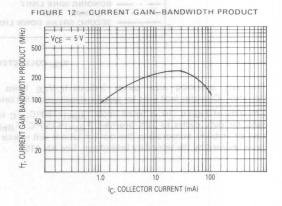


FIGURE 13 - THERMAL RESPONSE

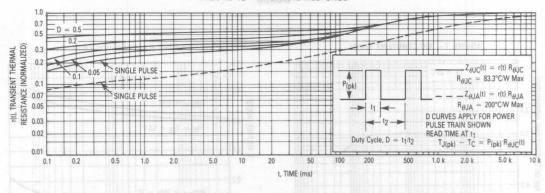
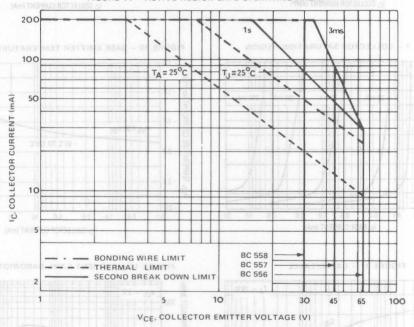


FIGURE 14 - ACTIVE REGION SAFE OPERATING AREA



The safe operating area curves indicate IC-VCE limits of the transistor that must be observed for reliable operation. Collector load lines for specific circuits must fall below the limits indicated by the applicable curve.

The data of Figure 14 is based upon $T_J(pk)=150^{\circ}C$; T_C or T_A is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided $T_J(pk) \le 150^{\circ}C$. $T_J(pk)$ may be calculated from the data of Figure 13. At high case or ambient temperatures thermal limitations will reduce the power that can be handled to values less than the limitations imposed by the secondary breakdown. (see AN 415).

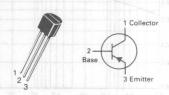
Rating	Symbol	BC 559	BC 560	Unit	
Collector-Emitter Voltage	VCEO	30	45		
Collector-Base Voltage	VCBO	30	50	Vdc	
Emitter-Base Voltage	VEBO	5.0		Vdc	
Collector Current - Continuous	IC	100		mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W	
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W	

BC559,B,C BC560,B,C

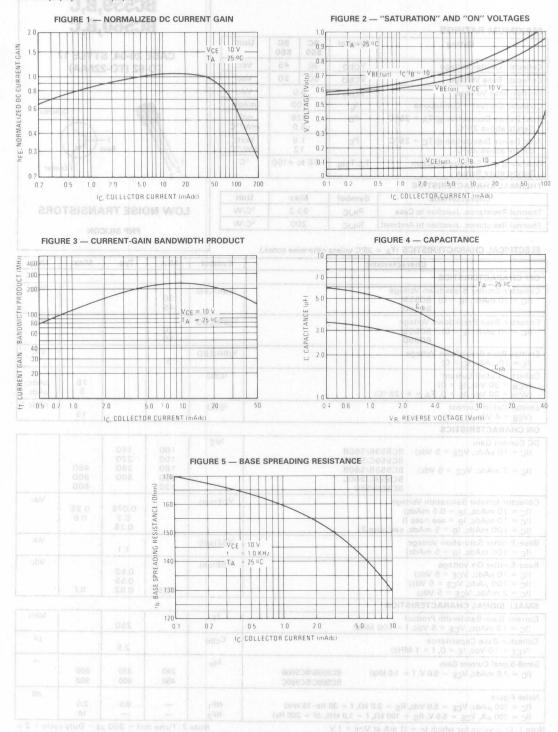
CASE 29-04, STYLE 17 TO-92 (TO-226AA)



LOW NOISE TRANSISTORS

PNP SILICON

Characteristic	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS					H H
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, I _B = 0) BC559 BC560	V(BR)CEO	30 45			Vdc
Collector-Base Breakdown Voltage (IC = 10 µAdc, IE = 0) BC559 BC560	V(BR)CBO	30 50			Vdc
Emitter-Base Breakdown Voltage (IE = 10 μAdc, IC = 0)	V(BR)EBO	5			Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0) (VCB = 30 Vdc, IE = 0, TA = + 125 °C)	СВО			15 5	nAdα μAdα
Emitter Cutoff Current (VEB = 4 Vdc, IC = 0)	IEBO	DE OF B	01	15	a nAdd
ON CHARACTERISTICS				,	
DC Current Gain (IC = 10 μ Adc, VCE = 5 Vdc) (IC = 2 mAdc, VCE = 5 Vdc) BC559B/560B BC559C/560C BC559/560C BC559/560C BC559/560C	hFE B — a BRUDA	100 100 180 380 120	150 270 290 500	460 800 800	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc) (I _C = 10 mAdc, I _B = see note 1) (I _C = 100 mAdc, I _B = 5 mAdc, see note 2)	VCE(sat)	E STANTE	0.075 0.3 0.25	0.25 0.6	Vdc
Base-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 5 mAdc)	VBE(sat)	MO BE	1.1		Vdc
Base-Emitter On Voltage (IC = 10 μAdc, VCE = 5 Vdc) (IC = 100 μAdc, VCE = 5 Vdc) (IC = 2 mAdc, VCE = 5 Vdc)	VBE(on)	0.55	0.52 0.55 0.62	0.7	Vdc
SMALL SIGNAL CHARACTERISTICS		3			
Current-Gain-Bandwidth Product (IC = 10 mAdc, VCE = 5 Vdc, f = 100 MHz)	f _T	100	250		MHz
Collector-Base Capacitance (VCE = 10 Vdc, IE = 0, f = 1 MHz)	C _{cbo}		2.5		pF
Small-Signal Current Gain (I _C = 2.0 mAdc, V _{CE} = 5.0 V, f = 1.0 kHz) BC559B/BC560B BC559C/BC560C	h _{fe}	240 450	330 600	500 900	_
Noise Figure $(I_C = 200 \ \mu\text{Adc}, V_{CE} = 5.0 \ \text{Vdc}, R_S = 2.0 \ \text{k}\Omega, f = 30 \ \text{Hz} - 15 \ \text{kHz})$ $(I_C = 200 \ \mu\text{A}, V_{CE} = 5.0 \ \text{V}, R_S = 100 \ \text{k}\Omega, f = 1.0 \ \text{kHz}, \Delta f = 200 \ \text{Hz})$	NF ₁ NF ₂	Ξ	0.5	2.0	dB



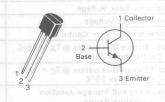
Rating	Symbol	BC 617	BC 618	Unit
Collector-Emitter Voltage	VCEO	40	55	Vdc
Collector-Base Voltage	VCBO	50	80	Vdc
Emitter-Base Voltage	VEBO	'EBO 12		Vdc
Collector Current - Continuous	IC	6A 1.0 0		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625		mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		r đã°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BC617 BC618

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



DARLINGTON TRANSISTORS

NPN SILICON

Refer to 2N6426 for graphs

Characte	eristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	(DIRES	100stree		distribute	ISTO		
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, VBE = 0)	ak	BC617 BC618	V(BR)CEO	40 55		Emit <u>or</u> Brei 0 mA <u>d</u> o, lg	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	06	BC617 BC618	V(BR)CBO	50 80	own <u>Vo</u> ltage	Sepa <u>B</u> reako	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	03	Both Types	V _{(BR)EBO}	12	- "	a larand on	Vdc
Collector Cutoff Current (VCE = 40 Vdc, VBE = 0) (VCE = 60 Vdc, VBE = 0)	5,0	BC617 BC618	ICES	_	wo Voltege	50 50	nAdd
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0)		BC617 BC618	ICBO	= (2°8	$0, \overline{0} = 1$	50 50	nAdd
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)		Both Types	IEBO	_		50	nAdd
ON CHARACTERISTICS	Sb				2.0 Vda	50 mAde Ve	
Collector-Emitter Saturation Voltage (I _C = 200 mA, I _B = 0.2 mA)	08- 08-	Both Types	VCE(sat)	g —	_	1.1	Vdc
Base-Emitter Saturation Voltage (IC = 200 mA, IB = 0.2 mA)	25	Both Types	V _{BE} (sat)		vation Voltag	1.6	Vdc
Current Gain			hFE		labytu pg =	gi posm ov	3
$(I_C = 100 \mu A, V_{CE} = 5.0 V)$		BC617 BC618		4000 2000	gs 20 Vdcl	ter On Volta 00 m∆de, Vg	endiana Le gi
$(I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V})$		BC617		10000	RISTRES	CHARACTE	HERADAY
$(I_C = 200 \text{ mA}, V_{CE} = 5.0 \text{ V})$		BC618 BC617 BC618		4000 20000 10000	th Product = 2.0 Vdc.	70000 50000)-jnasna i — gli
$(I_C = 1.0 \text{ A}, V_{CE} = 5.0 \text{ V})$		BC617 BC618		10000 4000	0.1=1.0	apaci ta nce 10 V al c, lg	Dangud Bovi
DYNAMIC CHARACTERISTICS		di 0				ecitorics	ged hear
Current-Gain Bandwidth Product (I _C = 500 mA, V _{CE} = 5.0 V, P = 10	00 MHz)	Both Types	fT	150	= 0, f_= 1.0 n < 300 µs,	0.5 <u>Vd</u> c. Ic Pulse Wid	MHz
Output Capacitance (VCB = 10 V, IE = 0, f = 1.0 MHz)			Cob	-	4.5	7.0	pF
Input Capacitance (VEB = 5.0 V, IE = 0, f = 1.0 MHz)			C _{ib}	-	5.0	9.0	pF

(AAS Rating SE OT	Symbol	BC 635	BC 637	BC 639	Unit
Collector-Emitter Voltage	VCEO	45	60	80	Vdc
Collector-Base Voltage	Vсво	45	60	80	Vdc
Emitter-Base Voltage	VEBO	5.0		2	Vdc
Collector Current - Continuous	IC	1.0 O		Adc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	Wm NWm	800 6.4		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.75		Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		1 99°C	

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HIGH CURRENT TRANSISTORS

NPN SILICON

BC639

CASE 29-04, STYLE 14 TO-92 (TO-226AA)

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	45	°C/W
Thermal Resistance, Junction to Ambient	RHJC	156	°C/W

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic

Characteristi	ic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage* (I _C = 10 mAdc, I _B = 0)		V(BR)CEO	45 60	(0 =	0 mAde, Vg	Vdc
	BC639	erena.	80	agsilioV nvyc	Base Breeke	ottello
Collector-Base Breakdown Voltage		V(BR)CBO			3 3000	Vdc
(I _C = 100 μAdc, I _E = 0)	BC635 BC637 BC639	Both Types	45 60 80	egstioV nv 0)	ass Breakdor 0 "Adda 1 g s	neimm = 3i)
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	SED	V(BR)EBO	5.0	10 =	40 Vdc, Vgg	Vdc
Collector Cutoff Current (VCB = 30 Vdc, I _E = 0, (VCB = 30 Vdc, I _E = 0, T _A = 125°C)	1080	ICBO VISOR	= .	= 10	100	nAdo μAdo
ON CHARACTERISTICS*		0193/3			Access of State	Sales Seine
DC Current Gain (I _C = 5.0 mAdc, V _{CE} = 2.0 Vdc)	Uas	angyT hFE	25	10		3877
(IC = 150 mAdc, V _{CE} = 2.0 Vdc)	BC635		40		250	AHO M
	BC637 BC639	Both Types	40 40		160	otralio = 31)
$(I_C = 500 \text{ mA}, V_{CE} = 2.0 \text{ V})$	Variate		25	apatinV n	Men Saluent	กลี-คละ
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)		VCE(sat)		0.2 r =4)	0.5	Vdc
Base-Emitter On Voltage (IC = 500 mAdc, VCE = 2.0 Vdc)		VBE(on)	_		30V1.04 00	Vdc
DYNAMIC CHARACTERISTICS	01	17908		5.0 V)	O TEA, VOE =	= 30
Current-Gain Bandwidth Product (I _C = 50 mAdc, V _{CE} = 2.0 Vdc, f = 100) MHz)	BCB18	_	200	35 V Ja m 00	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)		Cob	_		I = 30V. A 0.	pF
Input Capacitance (V _{BE} = 0.5 Vdc, I _C = 0, f = 1.0 MHz)		Cib			CHARACTE	pF
$(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$ Pulse Test: Pulse Width $\leq 300 \text{ us. Duty Cs}$	(cle 2 0%	Both Types	(cHM 00	(h Product	iein Baridwid 00 mA, Vies	iner

*Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle 2.0%.

FIG. 1 — ACTIVE REGION SAFE OPERATING AREA

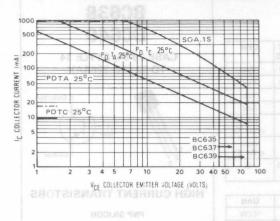


FIG. 2 — DC CURRENT GAIN

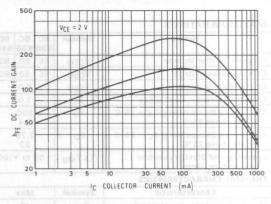
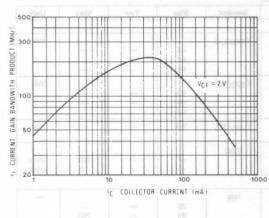
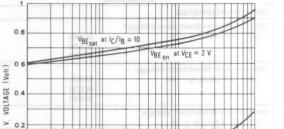


FIG. 3 — CURRENT GAIN BANDWIDTH PRODUCT

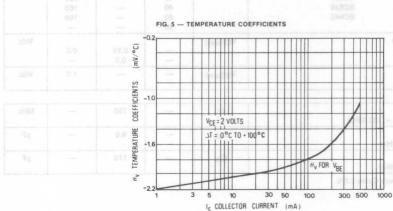






 $V_{CE_{sat}}$ at $I_{C}/I_{B} = 10$

FIG. 4 - "SATURATION" AND "ON" VOLTAGES



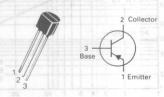
Rating	Symbol	BC 636	BC 638	BC 640	Unit
Collector-Emitter Voltage	VCEO	45	60	80	Vdc
Collector-Base Voltage	Vсво	45	60	80	Vdc
Emitter-Base Voltage	VEBO	1	5.0	5	Vdc
Collector Current - Continuous	IC		1.0		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		800 6.4		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		2.75		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55	to +	150	oo c

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	45	°C/W
Thermal Resistance, Junction to Ambient	R _H ,IC	156	°C/W

BC636 BC638 BC640

CASE 29-04, STYLE 14 TO-92 (TO-226AA)



HIGH CURRENT TRANSISTORS

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) TOUGORS HTGIWOMAR MIAO THBRRUO — F. SIR

Characteristic		Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS							
Collector-Emitter Breakdown Voltage* (IC = 10 mAdc, IB = 0)	BC636 BC638 BC640	8.0	V(BR)CEO	45 60 80			Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	BC636 BC638 BC640	A 0 (0)	V(BR)CBO	45 60 80			Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μ Adc, I _C = 0)		20 =	V(BR)EBO	5.0			Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0, (V _{CB} = 30 Vdc, I _E = 0, T_A = 125°C)	(1) [1] [1] [1] [1] [1] [1] [1] [1] [1] [1]	0	Ісво			100 10	nAdc μAdc
ON CHARACTERISTICS*							
DC Current Gain $(I_C=5.0 \text{ mAdc}, V_{CE}=2.0 \text{ Vdc})$ $(I_C=150 \text{ mAdc}, V_{CE}=2.0 \text{ Vdc})$ $(I_C=500 \text{ mA}, V_{CE}=2.0 \text{ V})$	BC636 BC638 BC640		hFE	25 40 40 40 40 25		250 160 160	_
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)			VCE(sat)	=	0.25 0.5	0.5	Vdc
Base-Emitter On Voltage (I _C = 500 mAdc, V _{CE} = 2.0 Vdc)			VBE(on)		69	1.0	Vdc
DYNAMIC CHARACTERISTICS				01	- 2		
Current-Gain Bandwidth Product (I _C = 50 mAdc, V _{CE} = 2.0 Vdc, f = 100 l	MHz)		fT Vec = 2 WATS		150	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	IN	30)	Cob	a	9.0	3 -	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	H ROL		C _{ib}		110	-	pF
Bules Test Bules Width - 200 - Duty Cur	1 0 000				No.		

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle 2.0%.

FIG. 1 — ACTIVE REGION SAFE OPERATING AREA

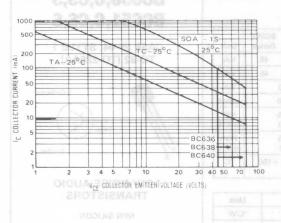


FIG. 2 — DC CURRENT GAIN

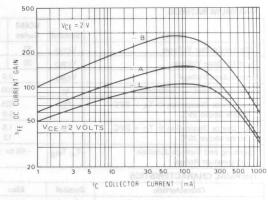
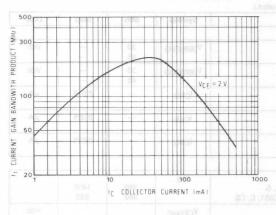
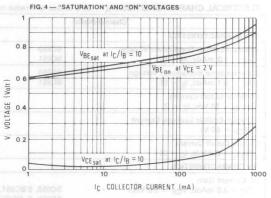
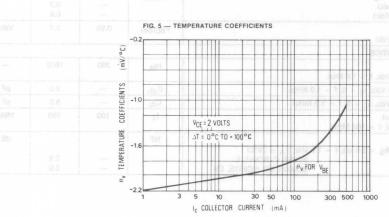


FIG. 3 — CURRENT GAIN BANDWIDTH PRODUCT





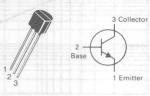


Rating	Symbol	BC650 Series	BC651 Series	Unit
Collector-Emitter Voltage	VCEO	30	45	Vdc
Collector-Base Voltage	VCBO	30	45	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current — Continuous	IC	200		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R_{θ} JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JC}$	200	°C/W

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



LOW NOISE AUDIO TRANSISTORS

NPN SILICON

TOUGOSS HTOWG Refer to MPSA18 for graphs.

Characteristic	С		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	BC650 BC651	8.0	V(BR)CEO	30 45		Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mAdc, I _E = 0)	BC650 BC651	a a o	V _(BR) CBO	30 45	X.I	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)		lag 5	ICBO		0.015	μΑ
Collector-Emitter Leakage Current (VCE = 60 V)			ICES		0.025	μА
Emitter Cutoff Current (V _{EB} = 6.0 Vdc, I _C = 0)		× 0.2	IEBO		0.015	μΑ
ON CHARACTERISTICS	I.L.	30				
DC Current Gain (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)		S/BC651, S C, CS/BC651, C, CS	hFE	380 380	1400 820	
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 0.5 mAdc) (IC = 100 mAdc, IB = 5.0 mAdc)			VCE(sat)	=	0.2 0.6	Vdc
Base Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)		ERATURE CONTRICERTS	V _{BE} (on)	0.55	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS				9		
Small-Signal Current Gain ($I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz}$)			h _{fe}	380	1600	_
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_{E} = 0$, $f =$	1.0 MHz)		Cob	<u> </u>	3.0	pF
Input Capacitance ($V_{EB} = 0.5 \text{ Vdc}$, $I_{C} = 0$, $f = 0$	1.0 MHz)		Cib	ē -	8.0	pF
Current-Gain Bandwidth Product (I _C = 1.0 mAdc, V _{CE} = 5.0 V, f = 100 MHz)		211945=29	fΤ	100	700	MHz
Noise Figure (VCE = 5.0 V, IC = 0.2 mA, RS = 2.0 k Ω , f =	BC650,	C, BC651, C C, CS, BC651S, CS	NF _{0.7}	TEARCHAIL	2.8 2.0	dB

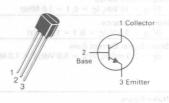
	Rating 035	Symbol	BCX 58	BCX 59	Unit
Collector-	Emitter Voltage	VCEO	32	45	Vdc
Collector-	Base Voltage	Vсво	32	45	Vdc
Emitter-B	ase Voltage	VEBO	7	.0	Vdc
Collector	Current - Continuous	IC	10	00	mAdc
	ce Dissipation @ TA = 25°C above 25°C	PD	62 5	25	mW mW/°C
	ce Dissipation @ T _C = 25°C above 25°C	PD	1.5 12		Watt mW/°C
	and Storage Junction ature Range	TJ, Tstg	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BCX58,-7,-8,-9,-10 BCX59,-7,-8,-9,-10

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



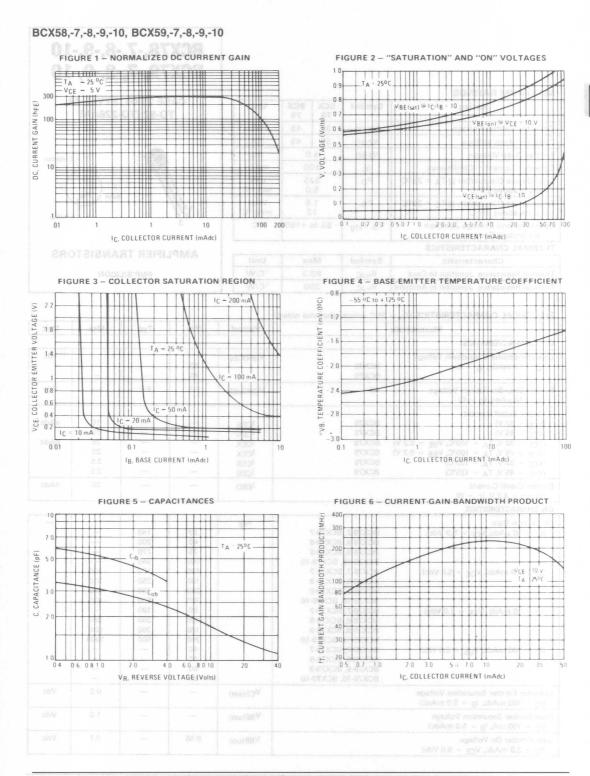
AMPLIFIER TRANSISTORS

NPN SILICON

Characteristic	151	Symbol	Min	SEL Typ GI	Max	Unit
OFF CHARACTERISTICS			117 901	- SH Its oud		
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IB = 0)	BCX58 BCX59	V(BR)CEO	32 45	_	f ico nio 1	Vdc
Emitter-Base Breakdown Voltage (I _E = 1.0 μAdc, I _C = 0)	All No	V _{(BR)EBO}	7.0	8.7	10 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -	Vdc
Collector Cutoff Current (VCE = 32 V) (VCE = 45 V) (VCE = 32 V, T _A = 100°C, V _{BE} = 0.2 V) (VCE = 32 V, T _A = 100°C, V _{BE} = 0.2 V)	BCX58 BCX59 BCX58 BCX59	ICES ICES ICEX ICEX	=		10 10 20 20	nAdc μAdc
$(V_{CE} = 32 \text{ V}, T_A = 125^{\circ}\text{C})$ $(V_{CE} = 45 \text{ V}, T_A = 125^{\circ}\text{C})$	BCX58 BCX59	ICES ICES	=	_	2.5 2.5	
Emitter-Cutoff Current (VEBO = 4.0 V, I _C = 0)		IEBO	-	_	20	nAdc
ON CHARACTERISTICS	」用品 5月基					
DC Current Gain (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)	BCX58-7, BCX59-7 BCX58-8, BCX59-8 BCX58-9, BCX59-9 BCX58-10, BCX59-10 BCX58-7, BCX59-7 BCX58-8, BCX59-8 BCX58-9, BCX59-9	hFE	20 40 75 100 120 180 250	80 145 220 300 170 250 350		
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 100 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc})$	BCX58-10, BCX59-10 BCX58-7, BCX59-7 BCX58-8, BCX59-8 BCX58-9, BCX59-9 BCX58-10, BCX59-10 BCX58-7, BCX59-7 BCX58-8, BCX59-8 BCX58-9, BCX59-9 BCX58-10, BCX59-10		380 80 120 160 240 40 45 60	500 190 260 380 550 —	630 400 630 1000 —	
Collector-Emitter Saturation Voltage (IC = 100 mAdc, IB = 5.0 mAdc)	B0A30-10, B0A33-10	V _{CE(sat)}	_	-	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 100 mA, I _B = 2.5 mAdc)		V _{BE(sat)}	_	-	1.0	Vdc
Base-Emitter On Voltage (IC = 2.0 mAdc, VCE = 5.0 Vdc)		V _{BE(on)}	0.55	_	0.7	Vdc

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.

CHARL BAR	Lan Lon	Charac	cteristic			Symbol	Min	Тур	Max	Unit
SMALL-SI	GNAL CHA	RACTERISTICS	60					691	THE RATTE	IN DEA
		idth Product CE = 5.0 V, f =	100 MHz)	inU -	жов	XOS f _T loden	125		- 8ati	MH
Output Ca	pacitance	= 0, f = 1.0 M		Vdc	45	Cob Gas	V	1.8 apa	4.5	pF
nput Capa	citance	= 0, f = 1.0 MH		Vdc	O.	C _{ib}	X -	5.2	15	pF
		5.0.1	2)	- six A cir	- 00	. 35		augunited	L-mesu)	ctsell
		CE = 5.0 Vdc, f	= 1.0 kHz)	BCX58-7, BCX BCX58-8, BCX BCX58-9, BCX	59-8 59-9	h _{fe}	125 175 250	on @ <u>T</u> A = 15	250 350 500	ore C To ore et al ore C To ore C To
Noise Figu	11/2/11		E .	BCX58-10, BCX	X59-10	NF NF	350	AntianuLe	700	dB
		CE = 5.0 Vdc, f	Rs = 2.0 koh	ms, f = 1.0 kHz)				1.0	6.0	913 2010
(Ic = 10	mA, IR1	= 1.0 mA, I _{B2} =	= 1.0 mA)			Td		16	DARIENU	ns
(VBB =	3.6 V, R ₁	$= R_2 = 5.0 \text{ k}\Omega$				Tr today	, a a	29	Challegh	
(RL = 9	99 ohms)	MINE MAN				Ton			150	li lumis
*See tes	t circuit					T _S	Jnak	4/5	A THE STATE OF	N Asimse
						Tf	_	40	_	
				1.0	terom egi	Toff	7A- 284	515	800	ECTAR)
(IC = 10	0 mA, IR1	= 10 mA, I _{B2}	= 10 mA)	learny8	BLOOK - IN	td	attains	5.0		ns
(VBB =	5.0 V, R ₁	$=$ 500 Ω , R ₂ $=$	700 Ω)			t _r		40		
$(R_L = 9)$	B ohms)					ton		45	150	FICHAR
You								dawn Vollage		-1/ Joell
*See tes	t circuit					t _S	- BI	135	e igili a s Am	1 - 5
						t _f eax	8 -	80	_	
abV						toff	100	215	800	Fil. sorti
								10	ni sbAu t	ll = H
						VBB +10 V	ACC)			
						T				
						₹R ₂	RL			
		1 µs				* *				
		-			R ₁	1000		= 5.0 Vdel C		
		+10	V 50	0	WW -	OK BOX B				
		1000	25			6 BOX 9		to oscilloscop	е	
				\$	0 01-	158-10, BCN 82		t _r < 5 ns		
		TR < 5 ns		₹50	25	1N4935		Z _B ≥ 100 KS	y shaor o	
		B ₁ = 50 ()				SERVER BOX B-		-0 - 100 1/2		
		$R_J = 50 \Omega$ V < 0 01				K58-9, BCX10-	18	771.77		
				0	1011	(53-10, BOXes)		
						448.7, BCX59-	92			
						CESS 6 BCX59				
			45							



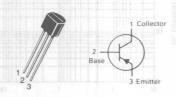
Rating	Symbol	BCX 78	BCX 79	Unit
Collector-Emitter Voltage	VCEO	32	45	Vdc
Collector-Base Voltage	Vсво	32	45	Vdc
Emitter-Base Voltage	VEBO	5	5.0	
Collector Current - Continuous	Ic	10	100	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		25 .0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to	+150	0% 88°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BCX78,-7,-8,-9,-10 BCX79,-7,-8,-9,-10

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

PNP SILICON

FLECTRICAL	CHARACTERISTICS	ITA -	25°C unless	otherwise no	(hate

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	11 3					
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	BCX78 BCX79	V(BR)CEO	32 45			Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	All	V(BR)EBO	5.0	6.8		Vdc
Collector Cutoff Current	- et 5		Am-Si	- 27/ III		1.0
(V _{CE} = 32 V)	BCX78	ICES		466-1	10	nAdc
$(V_{CE} = 45 \text{ V})$	BCX79	ICES			10	35
$(V_{CE} = 32 \text{ V}, T_{A} = 100^{\circ}\text{C}, V_{BE} = 0.2 \text{ V})$	BCX78	ICEX		_	20	μAdc
$(V_{CE} = 45 \text{ V}, T_A = 100^{\circ}\text{C}, V_{BE} = 0.2 \text{ V})$	BCX79	ICEX	_		20	437540
$(V_{CE} = 32 \text{ V}, T_{A} = 125^{\circ}\text{C})$	BCX78	ICES	- 1str <u>Aus</u> y 13739	1960 <u>123</u> 8 gi-	2.5	
$(V_{CE} = 45 \text{ V}, T_{A} = 125^{\circ}\text{C})$	BCX79	ICES			2.5	
Emitter-Cutoff Current (VERO = 4.0 V, IC = 0)		IEBO	-	-	20	nAdc

ON CHARACTERISTICS

DC Current Gain		hFE				1
$(I_C = 10 \mu Adc, V_{CF} = 5.0 Vdc)$	BCX78-7, BCX79-7		20	140		
	BCX78-8, BCX79-8		40	200		
	BCX78-9, BCX79-9	The state of	75	270		
	BCX78-10, BCX79-10		100	340		
(I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)	BCX78-7, BCX79-7		120	170	220	
	BCX78-8, BCX79-8		180	250	310	
	BCX78-9, BCX79-9	1	250	350	460	
	BCX78-10, BCX79-10		380	500	630	
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	BCX78-7, BCX79-7		80	180		
	BCX78-8, BCX79-8		120	260	400	
	BCX78-9, BCX79-9		160	360	630	
	BCX78-10, BCX79-10		240	500	1000	
$(I_C = 100 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc})$	BCX78-7, BCX79-7		40	- 1		
	BCX78-8, BCX79-8	<u></u>	45	L		
	BCX78-9, BCX79-9	19	60	- "	11/1/10/20	
OBAMI TURREUR ROBERT IMANO	BCX78-10, BCX79-10		60	A SSUBRARY	-	
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 5.0 mAdc)		VCE(sat)	-	_	0.6	Vdc
Base-Emitter Saturation Voltage (I _C = 100 mA, I _B = 5.0 mAdc)		V _{BE(sat)}		-	1.0	Vdc
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)		V _{BE(on)}	0.55		0.7	Vdc

Characteristic AT 4-488	Symbol	Min	Тур	Max	Unit
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain Bandwidth Product (IC = 10 mAdc, V _{CE} = 5.0 V, f = 100 MHz)	fT		200		MHz
Output Capacitance (VCE = 10 Vdc, I _C = 0, f = 1.0 MHz)	C _{ob}		2.6	4.5	pF
Input Capacitance (VBE = 0.5 V, I _C = 0, f = 1.0 MHz)	Cib		8.5	15	pF
Small-Signal Current Gain (IC = 2.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz) BCX78-7, BCX79-7 BCX78-8, BCX79-8 BCX78-9, BCX79-9 BCX78-10, BCX79-10	h _{fe}	125 175 250 350	200 260 330 520	250 350 500 700	
Noise Figure $(I_C = 0.2 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, R_g = 2.0 \text{ kohms}, f = 1.0 \text{ kHz})$	NF	TANK TANK	1.0	6.0	dB
$(I_C = 10 \text{ mA}, I_{B1} = 1.0 \text{ mA}, I_{B2} = 1.0 \text{ mA})$ $(V_{BB} = 3.6 \text{ V}, R_1 = R_2 = 5.0 \text{ k}\Omega)$ $(R_L = 999 \text{ ohms})$	T _d T _r T _{on}	HOSTARUTA	17 27 44	_ 	nS
*See test circuit	T _s T _f T _{off}	-1/=	400 60 460	800	
$(I_C = 100 \text{ mA}, I_{B1} = 10 \text{ mA}, I_{B2} = 10 \text{ mA})$ $(V_{BB} = 5.0 \text{ V}, R_1 = 500 \Omega, R_2 = 700 \Omega)$ $(R_L = 98 \text{ ohms})$	t _d t _r t _{on}	An 00 -	5.0 20 25	150	ns
*See test circuit	t _s t _f toff		130 40 170	800	

TEST CIRCUIT

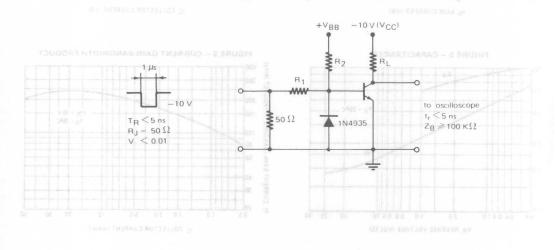


FIGURE 1 - NORMALIZED DC CURRENT GAIN

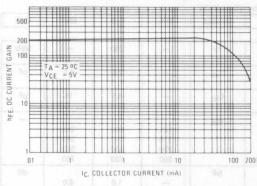
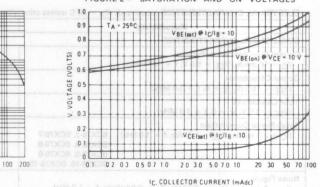


FIGURE 2 - "SATURATION" AND "ON" VOLTAGES



Voc = 5.0 Voc, R_d = 2.0 kelvas, t = 1.0 kHzt = 1.0

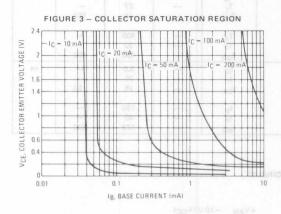


FIGURE 4 - BASE EMITTER TEMPERATURE COEFFICIENT

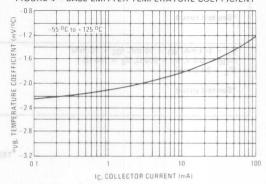


FIGURE 5 - CAPACITANCES

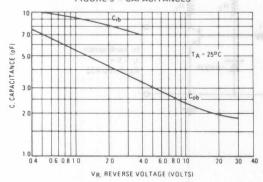
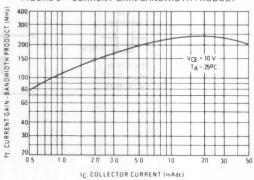


FIGURE 6 - CURRENT GAIN-BANDWIDTH PRODUCT



Rating	Symbol	BDB 01A	BDB 01B		BDB 01D	Unit
Collector-Emitter Voltage	VCEO	45	60	80	100	Vdc
Collector-Base Voltage	VCES	45	60	80	100	Vdc
Emitter-Base Voltage	VEBO		5	Vdc		
Collector Current - Continuous	IC		0.5			
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		1.0 8.0			
Total Device Dissipation @ T _C = 25°C Derate above 25°C	₩ PD	20 3 40 33 3			Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150			°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _H JC	50	°C/W
Thermal Resistance, Junction to Ambient	RHJC	125	°C/W

BDB01A Thru BDB01D

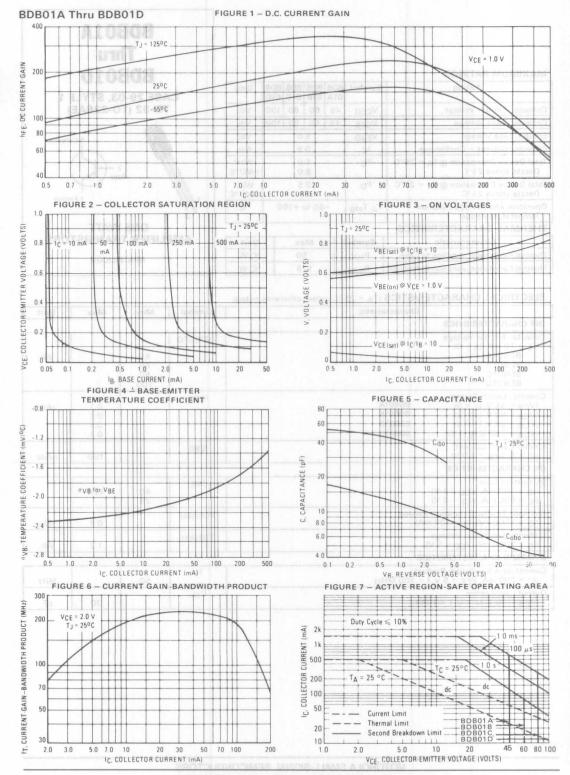
CASE 29-03, STYLE 1 TO-92 (TO-226AE)



ONE WATT
AMPLIFIER TRANSISTORS

NPN SILICON

Characteristic	Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS	1			THEFT
Collector-Emitter Voltage (I _C = 10 mA, I _B = 0)	V(BR)CEO			W.
BDB01A BDB01B BDB01C BDB01D BDB01D BDB01D	Q1 Q2 (A-ts	45 60 80 100	0 10	Vdc
Collector Cutoff Current (VCB = 45 V, IE = 0) BDB01A (VCB = 60 V, IE = 0) BDB01B (VCB = 80 V, IE = 0) BDB01C (VCB = 100 V, IE = 0) BDB01D	ICBO	1900 3807	0.1 0.1 0.1 0.1	μAdc
Emitter Cutoff Current (IC = 0, VEB = 5.0 V)	IEBO		100	nAdd
ON CHARACTERISTICS				
DC Current Gain (I _C = 100 mA, V _{CE} = 1 V) (I _C = 500 mA, V _{CE} = 2 V)	hFE	40 25	400	
Collector-Emitter Saturation Voltage (IC = 1000 mA, IB = 100 mA)	VCE(sat)		0.7	Vdc
Collector-Emitter on Voltage (IC = 1000 mA, VCE = 1 V)	VBE(on)		1.2	Vdc
DYNAMIC CHARACTERISTICS	c 00: 04	ne na r	2 05	n 1 2/
Current Gain Bandwidth Product (I _C = 200 mA, V _{CE} = 5 V, f = 100 MHz)	f _T (m) tis	50	100 pl	MHz
Output Capacitance (VCB = 10 V, IE = 0, f = 1 MHz)	Cob		30	pF
Daty Spale < 10%			V 0.0 -	
000 5 000 5				



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

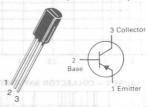
Rating	Symbol	BDB 02A		BDB 02C	BDB 02D	Unit
Collector-Emitter Voltage	VCEO	45	60	80	100	Vdc
Collector-Base Voltage	VCES	45	60	80	100	Vdc
Emitter-Base Voltage	VEBO	5.0			Vdc	
Collector Current - Continuous	IC	0.5			Adc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1.0			Watt mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	(Am) TV 2.5 V3 ROTOS 20			Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150			°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	50	°C/W
Thermal Resistance, Junction to Ambient	RH.IC	125	°C/W

BDB02A Thru BDB02D

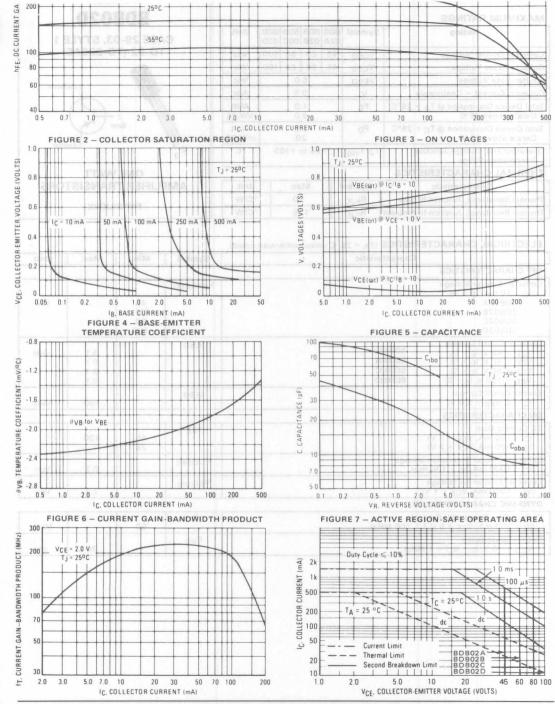
CASE 29-03, STYLE 1 TO-92 (TO-226AE)



ONE WATT AMPLIFIER TRANSISTORS

PNP SILICON

Characteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS					14
Collector-Emitter Voltage (IC = 10 mA, IB = 0)		V(BR)CEO			
BDB02A SE	20 50	RETTIME	45 60 80 100	FIGURE	Vdc
Collector Cutoff Current (VCB = 45 V, IE = 0) (VCB = 60 V, IE = 0) BDB02B (VCB = 80 V, IE = 0) BDB02C (VCB = 100 V, IE = 0) BDB02D		ІСВО		0.1 0.1 0.1 0.1	μAdc
Emitter Cutoff Current (IC = 0, VEB = 5.0 V)		IEBO		100	nAdc
ON CHARACTERISTICS			1-11	++	
DC Current Gain (I _C = 100 mA, V _{CE} = 1 V) (I _C = 500 mA, V _{CE} = 2 V)		hFE	40 25	400	9
Collector-Emitter Saturation Voltage (IC = 1000 mA, I _B = 100 mA)		VCE(sat)		0.7	Vdc
Collector-Emitter on Voltage (I _C = 1000 mA, V _{CE} = 1 V)	802 035	VBE(on)	18 29	1.2	Vdc
DYNAMIC CHARACTERISTICS 3284/38 gV		IAM) TW	знацэ потов	4J 03 .31	
Current Gain Bandwidth Product (I _C = 200 mA, V _{CE} = 5 V, f = 100 MHz)	TOUGGRA	нтолтоиля	50 TM3	PRUO - 8 BR	MHz
Output Capacitance (VCB = 10 V, IE = 0, f = 1 MHz)		Сор		30	pF
2 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0					



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

BDC02A

MAXIMUM RATINGS

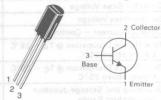
CASE 29-00, STYLE 14	Symbol	BDC 01A	BDC 01B		BDC 01D	Unit
Collector-Emitter Voltage	VCEO	45	60	80	100	Vdc
Collector-Base Voltage	Vсво	45	60	80	100	Vdc
Emitter-Base Voltage	VEBO	SBV	5	.0	5.0	Vdc
Collector Current - Continuous	IC	0.55/4	1	.5	1.5	Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	11 a 14 V		.0	0.1	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	HsVA F\Ve	-	.5	2.5 20	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	34-	55 to	+15	0	i B −°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	50	°C/W
Thermal Resistance, Junction to Ambient	RHJC	125	°C/W

BDC01A Thru BDC01D

CASE 29-03, STYLE 14 TO-92 (TO-226AE)



ONE WATT AMPLIFIER TRANSISTORS

NPN SILICON

Refer to BDB01A for graphs.

Charac	teristic	Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS			103	RACTERIST	AHO INO
Collector-Emitter Voltage (IC = 10 mA, IB = 0) BDC01A BDC01B BDC01B BDC01C BDC01D	ViBric	V(BR)CEO	45 60 80 100	Emilter Vol. 0 mA Jg = 1 202A 202B 202C 202C	Vdc
Collector Cutoff Current (VCB = 45 V, IE = 0) BDC0 (VCB = 60 V, IE = 0) BDC0 (VCB = 80 V, IE = 0) BDC0 (VCB = 100 V, IE = 0) BDC0	01B 01C	ICBO	to: () ()	0.1 0.1 0.1 0.1	μAdc
Emitter Cutoff Current (IC = 0, VEB = 5.0 V)	083	IEBO		100	nAdc
ON CHARACTERISTICS			CS	TRIPETTOAF	AHD MO
DC Current Gain (IC = 100 mA, VCE = 1 V) (IC = 500 mA, VCE = 2 V)	344	hFE	40 25	400	
Collector-Emitter Saturation Voltage (IC = 1000 mA, IB = 100 mA)	VCErsa	VCE(sat)	stioV nedsol	0.7	Vdc
Collector-Emitter on Voltage (IC = 1000 mA, VCE = 1 V)	VBE(or	VBE(on)	epetic/	1.2	Vdc
DYNAMIC CHARACTERISTICS			ERISTICS	CCHARACT	May 18
Current Gain Bandwidth Product (IC = 200 mA, VCE = 5 V, f = 100 M	ЛНz)	f _T	50	ain Bandwid 19 No Am Of	MHz
Output Capacitance (VCB = 10 V, IE = 0, f = 1 MHz)	do ⁹	Cob	SHM I = 1	30	pF

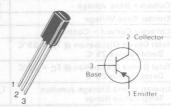
Rating Sound RAD	Symbol		BDC 02B		BDC 02D	Unit
Collector-Emitter Voltage	VCEO	45	60	80	100	Vdc
Collector-Base Voltage	Vсво	45	60	80	100	Vdc
Emitter-Base Voltage	VEBO	abV	5	.0	8.0	Vdc
Collector Current - Continuous	IC	aba	1	.5	1.5	Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	HEW.		.0	0.1	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	SteWi P\W		.5	2.5	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-30v-	55 to	+15	0 0	e °C

THERMAL CHARACTERISTICS

Characteristic Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	50	°C/W
Thermal Resistance, Junction to Ambient	RHJC	125	°C/W

BDC02A Thru BDC02D

CASE 29-03, STYLE 14 TO-92 (TO-226AE)



ONE WATT AMPLIFIER TRANSISTORS

PNP SILICON

Refer to BDB02A for graphs.

120 KeW INW CI	naracteristic	Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS			501	GLEG LOVUS	MIND THE
Collector-Emitter Voltage (IC = 10 mA, IB = 0) BDC02A BDC02B BDC02B BDC02C BDC02D	(190(88))	V(BR)CEO	45 60 80 100	0 HA 18 = 2 A HA C A TO 2 D TO L O TO C	Vdc
Collector Cutoff Current (VCB = 45 V, IE = 0) (VCB = 60 V, IE = 0) (VCB = 80 V, IE = 0) (VCB = 100 V, IE = 0)	Oali	ICBO Das Broods Droods Groods	6 6 6 60	0.1 0.1 0.1 0.1	μAdc
Emitter Cutoff Current (IC = 0, VEB = 5.0 V)	0.83	IEBO	A A	100	nAdc
ON CHARACTERISTICS			60	TEMBTOR	MHO NO
DC Current Gain (IC = 100 mA, VCE = 1 V) (IC = 500 mA, VCE = 2 V)	34%	hFE	40 25	400	(tc = 1) (tc = 1)
Collector-Emitter Saturation Volt (IC = 1000 mA, IB = 100 mA)	age 1337	VCE(sat)	(Am 001 =	0.7	Vdc
Collector-Emitter on Voltage (IC = 1000 mA, VCE = 1 V)	(het/8V	VBE(on)	N I = 1	1.2	Vdc
DYNAMIC CHARACTERISTICS			SULLEINS	WARAGO .	THE RESIDENCE
Current Gain Bandwidth Product (I _C = 200 mA, V _{CE} = 5 V, f = '	100 MHz)	T _{IM} oo	50	aby pun of	MHz
Output Capacitance (VCB = 10 V, IE = 0, f = 1 MH;	do?	Cob	sHM (= 1 .	30	pF

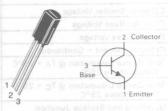
Rating Se-OT	Symbol	BDC 05	BDC 07	Unit
Collector-Emitter Voltage	VCEO	300	250	Vdc
Collector-Base Voltage	VCBO	300	250	Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current - Continuous	IC	500		mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1 8.0		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 50		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	50	°C/W
Thermal Resistance, Junction to Ambient	RHJC	125	°C/W

BDC07

CASE 29-03, STYLE 14 TO-92 (TO-226AE)



HIGH VOLTAGE TRANSISTORS

NPN SILICON

Refer to MPSW42 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted) and appropriate the state of the

Cha	racteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS				801	RASTERIST	AIRS PRO
Collector-Emitter Breakdown Volta (Ic = 1 mAdc, IB = 0)	ge (1)	BDC05 BDC07	V(BR)CEO	300 250	Emitter Brei mAdo, ig =	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc$, $I_E = 0$)	V(вя)сво	BDC05 BDC07	V(BR)CBO	300 250	Sasa Break 30 µAdc. Ig	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μAdc, IC = 0)	Vienieso	BDC05 BDC07	V(BR)EBO	5.0 5.0	eso Broakdo 10 pAdc. IC	Vdc
Collector Cutoff Current (V _{CB} = 200 Vdc, I _E = 0)	0801	BDC05 BDC07	СВО		0.01	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	083	BDC05 BDC07	IEBO	(0	namuo man 51 ,10 o a	μAdc
ON CHARACTERISTICS				50	ACTERISTIC	HARD IN
DC Current Gain (IC = 25 mAdc, VCE = 20 Vdc)	344	BDC05 BDC07	hFE	(40 os 50	I MA. VCE	emi y a Ng = 21
Collector-Emitter Saturation Voltage (IC = 20 mAdc, IB = 2.0 mAdc)	ye Veetsett		VCE(sat)	ration Volta 2.0 mAdot	enitter Satural	Vdc
Base-Emitter Saturation Voltage (IC = 20 mA, IB = 2.0 mA)	(382)38V		VBE(sat)	agattoV no (Ans O	2.0	Vdc
DYNAMIC CHARACTERISTICS				ENISTICS	CHARACT	HIS AVITS
Current Gain-Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f	= 50 MHz)		fT SHM 08 =	60	en - Bandwill mAdc. Vos	MHz
Collector-Base Capacitance (VCB = 30 Vdc, IE = 0, f = 1.0 N	1Hz)		Cre	lance O I = 1 O I	08g80 08s3	pF

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

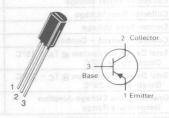
Rating	Symbol	BDC 06	BDC 08	Unit
Collector-Emitter Voltage	VCEO	300	250	Vdc
Collector-Base Voltage	VCBO	300	250	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current - Continuous	Ic	500		mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1 8.0		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55 to	+150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	50	°C/W
Thermal Resistance, Junction to Ambient	RHJC	125	°C/W

BDC06 BDC08

CASE 29-03, STYLE 14 TO-92 (TO-226AE)



HIGH VOLTAGE TRANSISTORS

PNP SILICON

Refer to MPSW92 for graphs.

hou xaw Cha	racteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS				6,11	TGIRGUI O AZIV	- (15) +31
Collector-Emitter Breakdown Volta (IC = 1 mAdc, IB = 0)	ge (1)	BDC06 BDC08	V(BR)CEO	300 250	æ gl ,abAm	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	V(BRICEO.	BDC06 BDC08	V(BR)CBO	300 250	3LabAn.09	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	VERNERO	BDC06 BDC08	V(BR)EBO	5.0 5.0	JI JABAL UL	Vdc
Collector Cutoff Current (VCB = 200 Vdc, IE = 0)	080	BDC06 BDC08	ІСВО	(0 =	0.01	μAdo
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	0681	BDC06 BDC08	IEBO	(0 =	10	μAdo
ON CHARACTERISTICS				6.0	fancarda y cont	O GREEN W
DC Current Gain (IC = 25 mA, VCE = 20 Vdc)	35/1-	BDC06 BDC08	hFE	40 50	MV45 NO	= 51)
Collector-Emitter Saturation Voltage (IC = 20 mAdc, IB = 2.0 mAdc)	ge Maria Nov		VCE(sat)	2.0 mAda)	2	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mA, I _B = 2.0 mA)	VESISEV		VBE(sat)	(Am 0	2.0	Vdc
DYNAMIC CHARACTERISTICS				oun on a	TOPERATO)	0.17550(27)
Current Gain-Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f	= 50 MHz)		est for -	60	13V zbAni	MHz
Collector-Base Capacitance (VCB = 30 Vdc, I _E = 0, f = 1.0 N	1Hz)		C _{re}	0, f = 1.0.1	2.8	pF

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

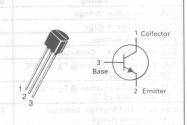
Rating	Symbol	Value el	Unit
Collector-Emitter Voltage	VCEO	ob/ 25	Vdc
Collector-Base Voltage	Vсво	40	Vdc
Emitter-Base Voltage	VEBO	sbv 4.0	Vdc
Collector Current - Continuous	IC	b4 100	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 NA 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	of dec

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	125	°C/W
Thermal Resistance, Junction to Ambient	RHJC	357	€°C/W

BF199

CASE 29-04, STYLE 21 TO-92 (TO-226AA)



RF TRANSISTOR

NPN SILICON

Refer to BF240 for graphs.

finU xsM qyT Ch	aracterist	ic odmy2		Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS						8311	SIMILITARY	ACTO INC
Collector-Emitter Breakdown Vo	tage 58	V(BE)CEO		V(BR)CEO	25	AMODALS	gl obAm	Vdc
Collector-Base Breakdown Vol (IC = 100 μAdc, IE = 0)	tage	VIBRICEO		V(BR)CBO	40	(0) = :	and exec D uAdc. I	Vdc
Emitter-Base Breakdown Volta (IE = 10 μAdc, IC = 0)	ge	083(88)¥		V(BR)EBO	4	lown yelfi = 0)	1 ot Au ov	Vdc
Collector Cutoff Current (VCB = 20 Vdc, IE = 0)		0801	o-es =	ICBO		10 =	100	nAdc
ON CHARACTERISTICS		088				Tri.	Salud Moto	3. 1.12.1.104
DC Current Gain (IC = 7 mAdc, VCE = 10 Vdc	:)			hFE	40	85	RETERIS	AHE M
Base-Emitter On Voltage (IC = 7 mAdc, VCE = 10 Vdc	e) US	het		VBE(on)		770	900	mVdc
SMALL-SIGNAL CHARACTER	ISTICS	(no)deV				9961	lov att ten	507U 2 19
Current Gain-Bandwidth Prod (IC = 5 mAdc, VCE = 10 Vdd		MHz) a BoV		fT	400	750	earning	MHz
Common Emitter Feedback Ca (VCB = 10 Vdc, IE = 0, f = 1				C _{re}	ISTICS	0.25	0.35	pF
Noise Figure (IC = 4 mA, VCE = 10 V, RS	= 50 Ω, f	= 35 MHz)		Nf	los (lc, f = 10)	2.5	vonse+ms v noAm c	dB
068				12000	1 52/1 - 1 3	ADM OF	A.J. W. A. P. C. S. C. S	

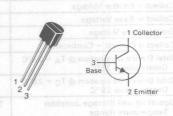
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30 Vete	Vdc
Collector-Base Voltage	VCBO	45	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current - Continuous	IC	bAm 50 0	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	or dec

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	RAJC	/\o_125	°C/W	
Thermal Resistance, Junction to Ambient	ReJC	357	°C/W	

BF224

CASE 29-04, STYLE 21 TO-92 (TO-226AA)



RF TRANSISTOR

NPN SILICON

Refer to BF240 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted) as a 47 20172493TOARAHO JACINTOBJ3

Characteris	stic odmye	Symbol	Min.	Э Тур.	Max.	Unit
OFF CHARACTERISTICS				2017	RACHERIE	OFF C:UA
Collector-Emitter Breakdown Voltage (IC = 1 mAdc, IB = 0)	Vівнусєю (V(BR)CEO	30	akdown Vo = 6)	si pakama	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	ViBroceo	V(BR)CBO	45	kelowin Vb (= 0)	iasti ars.a. 1. jako j	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)	V(BR)(BQ)	V(BR)EBO	4	down Volu = 0)	SteenS set O _Adb_fO	Vdc
Collector Cutoff Current (VCB = 20 Vdc, IE = 0)	080 TA = 25°C	ICBO		ther (0 =	100	nAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0)		IEBO		nos	100	nAdc
ON CHARACTERISTICS			(abV D1 = 1	mAde Vel	V = 50)
DC Current Gain (IC = 7 mAdc, VCE = 10 Vdc)	(no;38V	hFE	30	tege; = 10 Vet	rter On Vol mAdri, Vigi	Base-Lyri NC = 7
Base-Emitter On Voltage (IC = 7 mAdc, VCE = 10 Vdc)		VBE(on)	ISTICS	0.77	0.9	mVdc
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)		VCE(sat)	1001 = 1,	iov ot =	0.15	Vdc
SMALL-SIGNAL CHARACTERISTICS			SHM O	1-1.0-	al aby or	- 13V)
Current Gain-Bandwidth Product (IC = 1.5 mAdc, VCE = 10 Vdc, f = 10 (IC = 7 mAdc, VCE = 10 Vdc, f = 100		Thurst = 35 MHz)	300	600 850	agv ,Am	MHz
Common Emitter Feedback Capacitance (VCE = 10 Vdc, IE = 0, f = 1 MHz)		C _{re}		0.28		pF
Noise Figure $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, R_S =$	50 ohms, f = 100 MHz) f = 200 MHz	Nf		2.5 3.5		dB

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current - Continuous	IC	25	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

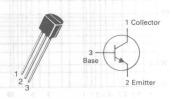
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _H JC	125	°C/W
Thermal Resistance, Junction to Ambient	R _θ JC	357	°C/W

BF240 BF241

SF2:0, BF241

CASE 29-04, STYLE 21 TO-92 (TO-226AA)



AM/FM TRANSISTORS

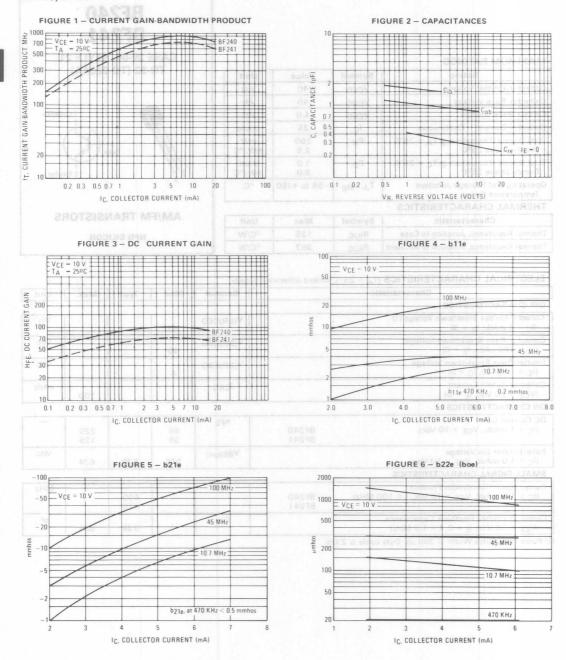
NPN SILICON

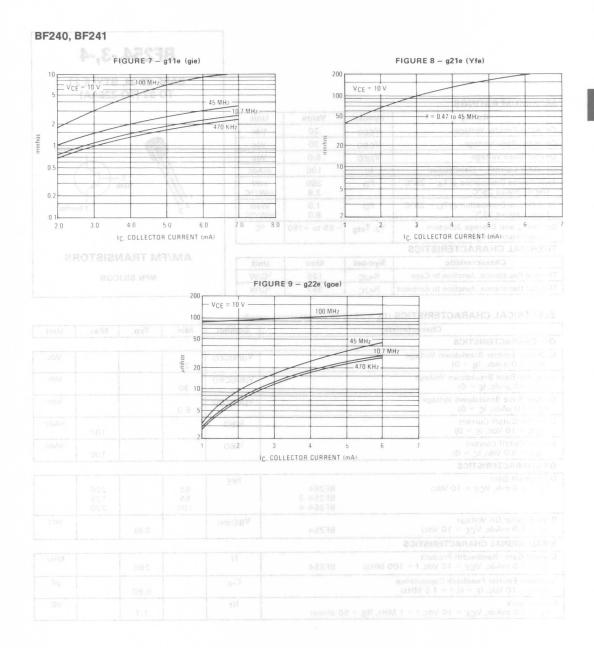
ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

Characteristic		Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS	105					- 60%
Collector-Emitter Breakdown Voltage (1) (IC = 1 mAdc, I _B = 0)	V(BR)CEO	40			Vele	
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	e e	V(BR)CBO	40			Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	4			Vdc	
Collector Cutoff Current (VCB = 20 Vdc, IE = 0)	ICBO			100	nAdc	
ON CHARACTERISTICS 8 8 8 8 8 8	13	0 20	3 8 7	2 7 7	per ans	VH.
DC Current Gain 1888 20 R033 200 31 (IC = 1 mAdc, VCE = 10 Vdc)	BF240 BF241	hFE (Am)	65 35	1091000 51	220 125	_
Base-Emitter On Voltage (IC = 1.0 mAdc, VCE = 10 Vdc)	VBE(on)	0.65	0.70	0.74	Vdc	
SMALL-SIGNAL CHARACTERISTICS	29101					
Current Gain – Bandwidth Product (IC = 1.0 mAdc, VCE = 10 Vdc, f = 100 MHz)	BF240 BF241	fT		600 470	101	MHz
Common Emitter Feedback Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz)	Cre		0.28	0.34	pF	

(1) Pulse test: Pulse Width \leq 300 μ s. Duty cycle \leq 2.0%.





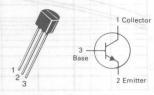


Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	Vсво	30	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current - Continuous	IC	100	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	RHJC	125	°C/W	
Thermal Resistance, Junction to Ambient	RHJC	357	°C/W	

CASE 29-04, STYLE 21 TO-92 (TO-226AA)



AM/FM TRANSISTORS

NPN SILICON

Characteristic		Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS			0.0		7	
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)		V(BR)CEO	20			Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)		V(BR)CBO	30			Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	5.0			Vdc
Collector Cutoff Current (VCB = 10 Vdc, IE = 0)		ICBO			100	nAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)	d F	IEBO			100	nAdc
ON CHARACTERISTICS						
DC Current Gain (I _C = 1.0 mA, V _{CE} = 10 Vdc)	BF254 BF254-3 BF254-4	hFE	65 65 100		220 125 220	
Base-Emitter On Voltage (IC = 1.0 mAdc, VCE = 10 Vdc)	BF254	VBE(on)		0.68		Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current Gain-Bandwidth Product (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	BF254	fŢ		260		MHz
Common Emitter Feedback Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz)		C _{re}		0.90		pF
Noise Figure (IC = 1.0 mAdc, VCE = 10 Vdc, f = 1 MHz, RS =	50 ohms)	Nf		1.7		dB

TYPICAL ADMITTANCE PARAMETERS (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, frequency as stated.)

	f = 450 kHz	sylak	f = 10.7 MHz	pnise M	
Symbol	BF254	BF254			spatioy Unit manufaction
911e	0.2 stay	3.5	0.26		mmhos
b11e	0.05 anv	0.3	1.2		mmhos
922e	3.0 ohAm	26	5.3		pmhos
b _{22e}	8.0 Wm	380	190	28°C	- AT © noite μmhose successful
b _{12e}	-5.0	8.5	-130		μmhos
912e	-0.7 DOLLAND	0.8	- 3.0	J-dZ	μmhos
921e	30	.55 to +150	30		mmhos
b _{21e}	- 0.003		-0.7		enmhos la marie

FIGURE 1 - DC CURRENT GAIN

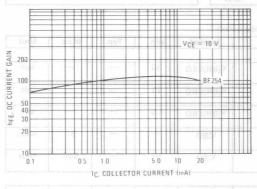


FIGURE 2 - CURRENT GAIN-BANDWITH PRODUCT

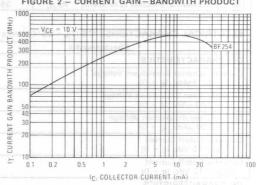
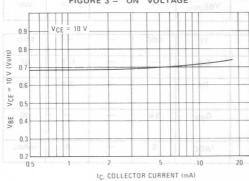
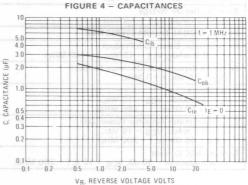


FIGURE 3 - "ON" VOLTAGE





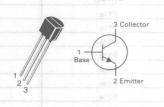
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	VCBO	35	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current - Continuous	IC 8	25	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _θ JC	125	°C/W
Thermal Resistance, Junction to Ambient	RHJC	357	°C/W

ELECTRICAL BESTICS (continued) ITA = 28.00 unless otherwise unread)

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



VHF TRANSISTOR

NPN SILICON

Characteristic		Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS	ONS 72					200
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	1001	V(BR)CEO	30			Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)		V(BR)CBO	35			Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	1 5 m	V(BR)EBO	4.0			Vdc
Collector Cutoff Current (VCB = 15 Vdc, IE = 0)	100	ICBO			50	nAdc
Collector Cutoff Current (VCE = 12 Vdc, IB = 0)	40, 1	ICEO	0.8	61	500	nAdc
ON CHARACTERISTICS			- reaneug-n	Utanasea ;		2000
DC Current Gain (IC $\stackrel{\perp}{=}$ 3.0 mAdc, V _{CE} = 10 Vdc) (IC = 12 mAdc, V _{CE} = 7.0 Vdc)		hFE	15 5.5	=	=	_
Base-Emitter On Voltage (IC = 12 mAdc, VCE = 7.0 Vdc)	gm (F	VBE(on)	VIAN A	0 <u>= 6</u>	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					VB1 4 35V	9.0
Current Gain-Bandwidth Product (IC = 3.0 mAdc, VCE = 10 Vdc, f = 100 MHz)	U.S.	fT	400			MHz
Feedback Capacitance (Common Emitter) (VCE = 10 Vdc, f = 1 MHz)	Total E	Crb			0.3	pF
Noise Figure ($I_C \approx 3.0$ mAdc, $V_{CB} \approx 10$ Vdc, $R_S = 50$ Ohms, $f = 200$ MHz)	10.1 N 10.4 N 10	Nf			3.5	dB
Common-Emitter Amplifier Power Gain (IC \approx 3.0 mAdc, VCB \approx 10 Vdc, RS = 50 Ohms, f = 200 MHz)	-69 W	Gpb	14			dB
Forward AGC Current (Gain Reduction = 30 dB, V _{CB} = 10 V, f = 200 M	IHz)	IAGC	5	-	8	mAdd

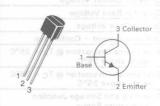
Rating Second	Symbol	BF 371	BF 373	Unit
Collector-Emitter Voltage	VCEO	30	45	Vdc
Collector-Base Voltage	Vсво	40	45	Vdc
Emitter-Base Voltage	VEBO	4	.0	Vdc
Collector Current - Continuous	IC at	10	00. 00	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1000	50 .8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1000	.0 0.	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to	+150	se °C gra

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	125 ac	°C/W
Thermal Resistance, Junction to Ambient	RHJC	357	°C/W

BF371 BF373

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



VHF TRANSISTOR

NPN SILICON

tinit I	v.n.8.6	(Characterist	ic	Symbol	Min	Тур	Max	Unit		
OFF CHA	RACTERIS	TICS		1000.70	l		J. J. G. H. J. G.	0.000	IGETTARAL	10 32 3	
	Collector-Emitter Breakdo		/oltage	V(BR)CEO	BF371 BF373	V(BR)CEO	30 45	reakdovm V	8 remines	Vdc	
	r-Base Brea 100 μAdc,	akdown Vol IE = 0)	tage of	V(BR)CBO	BF371 BF373	V _(BR) CBO	40 45	aledown Vole	or-Bass Sto 10 wwde, la	Vdc	
	Base Break 10 μAdc, Ι(down Volta	ge 0.8	V(BR)EBO		V(BR)EBO	4.0	down restra	Bas a Break 10 pAdc. Ic	Vdc	
	r Cutoff Cu = 30 Vdc, I			G83 ¹		ICBO	-	—108m (0 = 0)	6+ 6,0 0	nAdo	
ON CHA	RACTERIS	TICS		ona!				İns	muă Horu 3	16211713	
(I _C =		V _{CE} = 10 \		y		hFE	40	_8317	ARACTERIS	10 80	
(IC =	20 mAdc, \	$V_{CE} = 2.0$	/dc)	330			15	_	mist men	W4	
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)			-	1875	VCE(sat)	_ 10	N 01_= 30\	0.5	Vdc		
Base-Emitter On Voltage (IC = 7.0 mA, VCE = 10 Vdc)					V _{BE(on)}		_	0.9	Vdc		
DYNAM	IC CHARAC	CTERISTICS		1100190			foli	Am (0 = g	abam C. I	770	
		ndwidth Pro		MHz)	BF371 BF373	fŢ	400 500	720 720	10 mAde, 1) mrt(a <u>-</u> Satur	MHz	
		eedback Ca l _E = 0, f =		VBE(on)		C _{re}	- F3		0.32	pF	
bl/m		770					(0)	bV 01 = 30	O mAde, V	- 16	



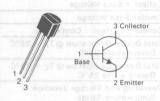
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current - Continuous	Ic	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	gg oC a

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	125	°C/W
Thermal Resistance, Junction to Ambient	RHIC	357	°C/W

BF374 BF375,C,D

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



VHF TRANSISTORS

NPN SILICON

Refer to MPSH10 for graphs.

ELECTRICAL CH	HARACTERISTICS ($T_{\Delta} =$	25°C u	nless othe	erwise noted)
---------------	------------------	----------------	--------	------------	---------------

Characteristic	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS			6311	SH31UAN	HD 410
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	25	(0 = E	d rester of	Vdc
Collector-Base Breakdown Voltage (IC = 10 μAdc, IE = 0)	V(BR)CBO	30	flo V raviolog (0 = 3	Send Send- 100 pApag	Vdc
Emitter-Base Breakdown Voltage $(IE = 10 \mu Adc, IC = 0)$	V(BR)EBO	3.0	town Volta = 0)	issa Breski 10 sAdo, ig	18°Vdc
Collector Cutoff Current — OBOL (VCB = 25 Vdc, IE = 0)	ІСВО			00 100 0 00 V 00	nAdc 80V
Emitter Cutoff Current (VEB = 2.0 Vdc, IC = 0)	IEBO		801	100	nAdc
ON CHARACTERISTICS		toh	V 01 = an\	Laladar 9.5	= 11)
DC Current Gain (IC = 1.0 mAdc, VCE = 10 Vdc) BF374 BF375 BF375C	hFE	70 35 70	cg = 2.0 \ turation Vi g = 2.0 mV	250 120 120	= 3D (deaths) = 3D
abV 0.0 — InotagV BF375D		35	regeri	90	Bene-E
Collector-Emitter Saturation Voltage (IC = 1.0 mAdc, IB = 0.1 mAdc) (IC = 10 mAdc, IB = 1.0 mAdc)	VCE(sat)		50 70	DAHAHD O	mVdc mVdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	VBE(sat)	ele, f = 1.00	830	Johan Ge	mVdc
Base-Emitter On Voltage (IC = 1.0 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc)	VBE(on)	(sHM 0.1	700 770	1.0 Vest. 1	mVdc mVdc
SMALL-SIGNAL CHARACTERISTICS					
Current Gain-Bandwidth Product (IC = 1.0 mAdc, VCE = 10 Vdc, f = 100 MHz)	fT	400	800		MHz
Common Emitter Feedback Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	Cre		0.55	0.6	pF
Collector-Base Time Constant (IC = 4.0 mAdc, VCE = 10 Vdc, f = 31.8 MHz)	r _b C _c		6		ps
Noise Figure (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 100 MHz, R_S = 50 ohms)	Nf		4		dB
Common-Emitter Amplifier Power Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 200 MHz)	Gpe		20		dB

TYPICAL ADMITTANCE PARAMETERS (IC = 1.0 mAdc, VCE = 10 Vdc, frequency as stated)

Symbol .	f = 10.7 MHz	f = 30 MHz	f = 100 MHz	Unit Unit
G11e 1 3JYT2 ,40-85 32AO	0.28	0.4	1.4	mmho
B11e (AA822-OT) 28-OT	0.6	000 001.6	5.0	mmho mmho
G22e	6.5	0000087000 08	20	pallov pmho
B22e	0.1	0.3	1.0	90010 mmho
G21e	36 35Am	0034	30 adddnis	mmho
B21e	- 0.8	- 2.5	0-29 AT 0	oping salmmho
B _{12e}	- 52	- 150	- 500	μmho

FIGURE 1 — INPUT ADMITTANCE
(Output short circuit)

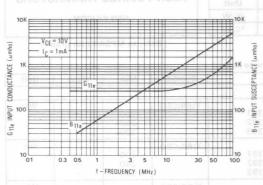


FIGURE 2 — OUTPUT ADMITTANCE (Input short circuit)

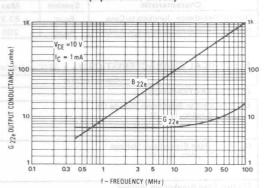


FIGURE 3 — FORWARD TRANSFER ADMITTANCE
(Output short circuit)

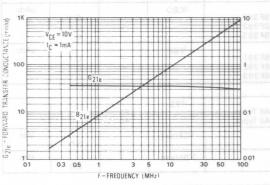
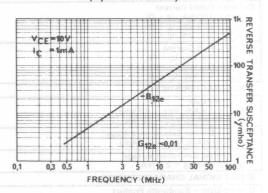


FIGURE 4 — REVERSE TRANSFER ADMITTANCE
(Input short circuit)



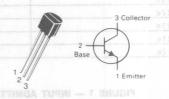
Rating SHM 001 =	Symbol	BF 391	BF 392	BF 393	Unit
Collector-Emitter Voltage	VCEO	200	250	300	Vdc
Collector-Base Voltage	Vсво	200	250	300	Vdc
Emitter-Base Voltage	VEBO	3	6.0		Vdc
Collector Current - Continuous	Ic	500		mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	d.	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		1.5 12		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _U JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	ReJC	200	°C/W

BF391 BF392 BF393

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

NPN SILICON

Refer to MPSA42 for graphs.

Characteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS	3 111				
Collector-Emitter Breakdown Voltage (1) (IC = 1.0 mAdc, IB = 0)	BF391 BF392 BF393	V(BR)CEO	200 250 300	1	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	BF391 BF392 BF393	V(BR)CBO	200 250 300	7 86 80	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μAdc, I _C = 0)	BF391 BF392 BF393	V(BR)EBO	6.0 6.0 6.0	7803 (Out	Vdc 3HUĐI
Collector Cutoff Current (VCB = 160 Vdc, IE = 0) (VCB = 200 Vdc, IE = 0) (VCB = 200 Vdc, IE = 0)	BF391 BF392 BF393	ІСВО		0.1 0.1 0.1	μAdc
Emitter Cutoff Current (VCB = 4.0 Vdc, IC = 0) (VCB = 6.0 Vdc, IC = 0) (VCB = 6.0 Vdc, IC = 0)	BF391 BF392 BF393	IEBO		0.1 0.1 0.1	μAdc
ON CHARACTERISTICS			74		
DC Current Gain (IC = 1.0 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc)	All Types All Types	hFE	25 40		- 01
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		VCE(sat)		2.0	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mA, I _B = 2.0 mA)	100 TTTTT	VBE(sat)	1	2.0	Vdc
SMALL SIGNAL CHARACTERISTICS		H.H.	MI- YORGUOTRI-	To the second	•
Current-Gain - Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 20 MHz)		fT	50	_	MHz
Common Emitter Feedback Capacitance (VCB = 60 Vdc, I _E = 0, f = 1.0 MHz)		C _{re}		2.0	pF

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

BF423

MAXIMUM RATINGS

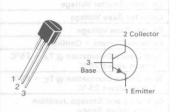
ALBUY Rating S BEAU	Symbol	BF 420	BF 422	Unit
Collector-Emitter Voltage	VCEO	300	250	Vdc
Collector-Base Voltage	VCBO	300	250	Vdc
Emitter-Base Voltage	VEBO	5	.0 0.	Vdc
Collector Current - Continuous	IC as	50	00 00	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1000	800 6.4	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD 1	2.		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55 to	+150	ed °C pi

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	45	°C/W
Thermal Resistance, Junction to Ambient	R _H JC	156	°C/W

BF420 BF422

CASE 29-04, STYLE 14 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

NPN SILICON

Refer to MPSA42 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

Characteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS			TICS	ARACTERIS	40, 420
Collector-Emitter Breakdown Voltage (1)	BF420 BF422	V(BR)CEO	300 250	gl .abAm !	Vdc
Collector-Base Breakdown Voltage SO(1991) (I _C = 100 μAdc, I _E = 0)	BF420 BF422	V(BR)CBO	300 250	3898 Bred 100 µAdc, 1	Vdc
Emitter Base Breakdown Voltage (IE = 100 μAdc, IC = 0)	85448 BF420 85449 BF422	V(BR)EBO	5.0 5.0	Basa Break 100 µAde. I	Vdc
Collector Cutoff Current (VCB = 200 Vdc, I _E = 0)	BF420 BF422	ICBO		0.01	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	BF420 BF422	IEBO	(D. =)	100	nAdc
ON CHARACTERISTICS			1103	ARACTERIS	HULD.
DC Current Gain (I _C = 25 mAdc, V _{CE} = 20 Vdc)	BF420 BF422	hFE	50 50	mise tre-	
Collector-Emitter Saturation Voltage (IC = 20 mAdc, IB = 2.0 mAdc)		VCE(sat)	turation Vs = 2.0 mAd	0.5	Vdc
Base-Emitter Saturation Voltage (IC = 20 mA, IB = 2.0 mA)		VBE(sat)	tion Voltagi 2.0 mAt	8 2.0	Vdc

SMALL SIGNAL CHARACTERISTICS

CHARLE CHARACTERIOTICS				
Current-Gain - Bandwidth Product (IC = 10 mAdc. VCE = 10 Vdc, f = 50 MHz)	t = 50 MHz	60	ons8 — sard D m∆dc. V	MHz
Common Emitter Feedback Capacitance (VCB = 30 Vdc, IE = 0, f = 1.0 MHz)	Cre	dbadk Car = 0, f = 1	1.6	pF

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

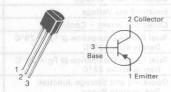
AAAS Rating	Symbol	BF 421	BF 423	Unit
Collector-Emitter Voltage	VCEO	300	250	Vdc
Collector-Base Voltage	Vсво	300	250	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current - Continuous	1c	50	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	-	00 .4	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.75 22		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		gg -∘C Bi

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	RHJC	45	°C/W	
Thermal Resistance, Junction to Ambient	RHJC	156	°C/W	

DF443

CASE 29-04, STYLE 14 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

PNP SILICON

Refer to MPSA92 for graphs.

Characteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS			TICS	ARACTERIS	HD 790
Collector-Emitter Breakdown Voltage (1) (I _C = 1 mAdc, I _B = 0)	BF421 BF423	V(BR)CEO	300 250	ir Emitter B 1 mAde, IB	Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	05414 BF421 8F423	V(BR)CBO	300 250	Pilse Brei OD uAdo, 1	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μAdc, IC = 0)	05448 BF421 65448 BF423	V(BR)EBO	5.0 5.0	100 pAdc, 1	Vdc
Collector Cutoff Current (VCB = 200 Vdc, I _E = 0)	BF421 BF423	ІСВО	(0 = 3) tous	0.01	μAdd
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	BF421 BF423	IEBO	10 = 1	100	nAdd
ON CHARACTERISTICS			eon	RACTERIS	AHO MO
DC Current Gain (I _C = 25 mA, V _{CE} = 20 Vdc)	05448 BF421 86448 BF423	hFE	50 50	em Gain 25 n uluis, V	160 50 1 = 5()
Collector-Emitter Saturation Voltage (IC = 20 mAdc, IB = 2.0 mAdc)		VCE(sat)	turation Vo = 2.0 mAd	0.5	Vdc
Base-Emitter Saturation Voltage (IC = 20 mA, IB = 2.0 mA)		VBE(sat)	tion Voltage 2.0 mA)	2.0	Vdc
SMALL SIGNAL CHARACTERISTICS		TICS	ARACTERIS	SIGNAL CH	J.AMS
Current-Gain - Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f = 50 MHz)		fT tau	60	ne8 - ms0- V ab la m 01	MHz
Common Emitter Feedback Capacitance (VCB = 30 Vdc, IE = 0, f = 1.0 MHz)		Cre	edback Cana = 0. f = 1.0	2.8	pF)

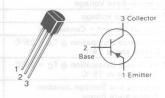
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMUM RATINGS Rating Symbol BF BF BF 491 492 493 Unit 200 250 300 Collector-Emitter Voltage VCEO Vdc Collector-Base Voltage 200 250 300 Vdc **VCBO** Emitter-Base Voltage VEBO 6.0 Vdc Collector Current - Continuous 500 mAdc IC 625 mW Total Device Dissipation @ TA = 25°C PD mW/°C Derate above 25°C 5.0 Total Device Dissipation @ T_C = 25°C Derate above 25°C PD 1.5 Watt mW/°C 12 Operating and Storage Junction Temperature Range -55 to +150 °C TJ, Tstg THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BF493

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

PNP SILICON

Refer to MPSA92 for graphs.

nill xaM nill Cha	racteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS				8	AACTERISTIC	MINT OF
Collector-Emitter Breakdown Volta (IC = 1 mAdc, IB = 0)	ge (1) gy	BF491 BF492 BF493	V(BR)CEO	200 250 300	Emiliar Brazil 0 m /st c. lg 8 scu <u>B</u> reakd	Vdc
Collector-Base Breakdown Voltage $(I_C = 100 \mu Adc, I_E = 0)$	V(BR)EBC	BF491 BF492 BF493	V(BR)CBO	200 250 300	ase <u>Bra</u> akdo 00 m <u>Ad</u> c. lg	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μAdc, IC = 0)	oeal	BF491 BF492 BF493	V(BR)EBO	6.0 6.0 6.0	.26d Vda) utoff Current 6.0 Vdc, IC	Vdc
Collector Cutoff Current (VCB = 160 Vdc, IE = 0) (VCB = 200 Vdc, IE = 0) (VCB = 200 Vdc, IE = 0)	080)	BF491 BF492 BF493	ICBO (Did	$I = AT \cdot 0 = I$ $I = AT \cdot 0 = I$	0.1 0.1 0.1	μAdc
Emitter Cutoff Current (VCB = 4.0 Vdc, IC = 0) (VCB = 6.0 Vdc, IC = 0) (VCB = 6.0 Vdc, IC = 0)	344	BF491 BF492 BF493	IEBO	(abV (ii) = 10 V(do)	0.1 0.1 0.1 0.1	μAdc
ON CHARACTERISTICS	(188) 7(3)			(ristate Paris)	= ust_utsArm 0:	0
DC Current Gain (IC = 1.0 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc)	VBE(sat)	All Types All Types	hFE	25 40	na O <u>n</u> Volta 0 mA <u>, Ig</u> =	nev <u>al</u> r L= o™
Collector-Emitter Saturation Voltage (IC = 20 mAdc, IB = 2.0 mAdc)	je		VCE(sat)	natro noth Produc	2.0	Vdc
Base-Emitter Saturation Voltage (IC = 20 mA, IB = 2.0 mA)	627		VBE(sat)	= 20 Vdc. f back Capaci	2.0	Vdc
SMALL SIGNAL CHARACTERISTI	cs		(si-the	0.1 = 1.0 =	100 Vdc. (g	- 60
Current-Gain — Bandwidth Produc (IC = 10 mAdc, VCE = 20 Vdc, f		.e^0	S = obyfydof = 2.	50	est. Pulse Wil	MHz
Common Emitter Feedback Capaci (VCB = 100 Vdc, IE = 0, f = 1.0			Cre		1.6	pF

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

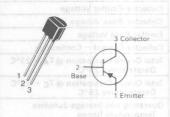
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	350	Vdc
Collector-Base Voltage	VCBO	350	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current - Continuous	IC 30	500	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

BF493S

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTOR

PNP SILICON

Refer to MPSA93 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

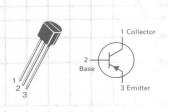
Wint Wax. Unit	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS				rics	AFACTERIS	OFF CIV
Collector-Emitter Breakdown Volta (I _C = 1.0 mAdc, I _B = 0)	ge(1) HARV	85491	V(BR)CEO	350	: Em <u>us</u> et Bri mAdc. Ig s	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)		8F493 8F493	V(BR)CBO	350		Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	Daglasia	3FA91 8FA92	V(BR)EBO	6.0	11.00=,00	Vdc
Collector Cutoff Current (VCE = 250 Vdc)	OSSISSIV	86448	ICES	girtloV nivo	10 20 See See See	nAdd
Emitter Cutoff Current (VBE = 6.0 Vdc, I _C = 0)		9F497 8F492	IEBO	_10 ×	0.1	μAdd
Collector Cutoff Current (V _{CB} = 250 Vdc, I _E = 0, T _A = 1 (V _{CB} = 250 Vdc, I _E = 0, T _A = 1		76436 56436	ICBO	ent e dT	0.005 1.0	μAdd
ON CHARACTERISTICS		BF493		(0 = 3	200 Vdg, l	30Y)
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	Geal	8F491 BF492	hFE	25 40	avaic hore. yi ab <u>v</u> o a ai ab <u>v</u> o a	Figures (VCB (VCB
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		0.07-10	VCE(sat)	831	2.0	Vdc
Base-Emitter On Voltage (I _C = 20 mA, I _B = 2.0 mA)	348	All Types	V _{BE} (sat)	:E = 10 Vde	2.0	Vdc
DYNAMIC CHARACTERISTICS	Maragold 1		tane	leV mesterus	-Emitter Sa	i taallaD
Current-Gain — Bandwidth Production (IC = 10 mAdc, VCE = 20 Vdc,			fT	bAn 50 S A	in m Life, Ig.	MHz
Common-Emitter Feedback Capac (V _{CB} = 100 Vdc, I _E = 0, f = 1.0			C _{re}	2.0 m <u>a)</u> Aracterii	1.6 HO JAMOIS	pF
) Pulse Test: Pulse Width ≤ 300 μ	s, Duty Cycle ≤ 2	2.0%.	1201 1 = 20 MHz)		Gain - Binne GanAdel Ve	

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	35	Vdc
Collector-Base Voltage	Vсво	40	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current - Continuous	IC	50	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic 7777 100 at	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _H JC	125	°C/W
Thermal Resistance, Junction to Ambient	R_{θ} JC	357	°C/W

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



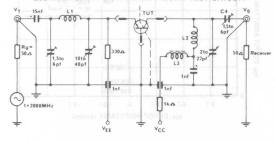
VHF TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

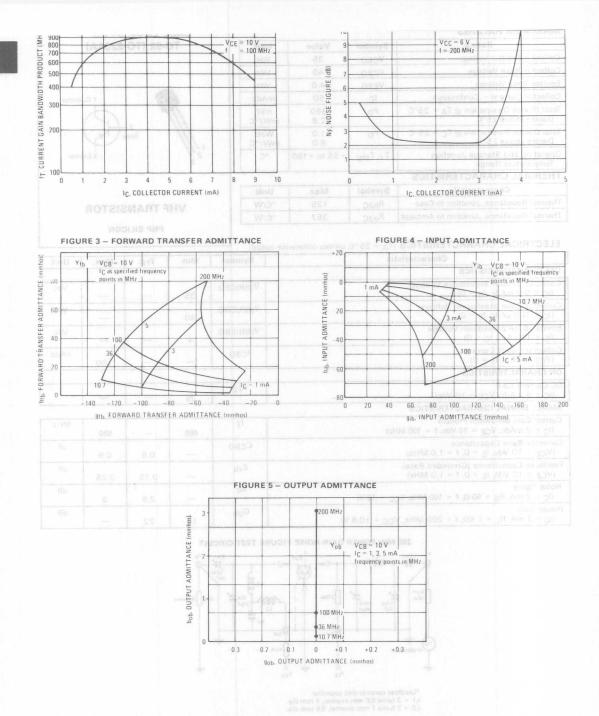
Characteristic	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS	1600	104	gangigan) back	to anua	
Collector-Emitter Breakdown Voltage (I _C = 5.0 mAdc, I _B = 0)	V(BR)CEO	35			Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	V(BR)CBO	40	7	-	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	V(BR)EBO	4		1001	Vdc
Collector Cutoff Current (VCB = 20 V, IE = 0)	ІСВО		X	100	nAdc
ON CHARACTERISTICS	1111				
DC Current Gain (IC = 3 mAdc, VCE = 10 Vdc)	hFE	25		oct.	
SMALL SIGNAL CHARACTERISTICS	Indoor 33	ratzionea si	LÍZIKARI LIDIN	WROR AN	
Current-Gain Bandwidth Product (I _C = 2 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fŢ	450	_	650	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	ССВО	_	0.6	0.9	pF
Feedback Capacitance (Grounded Base) (VCB = 10 Vdc, I _E = 0, f = 1.0 MHz)	C _{rb}		0.15	0.25	pF
Noise Figure (I _C = 2 mA, R _S = 50 Ω , f = 100 MHz, V _{CC} = 10 V)	N _F	_	2.5	3	dB
Power Gain (I _C = 3 mA, R _L = 1 K Ω , f = 200 MHz, V _{CC} = 10.8 V)	Gpb	14	22	_	dB

200 MHz POWER GAIN NOISE FIGURE TEST CIRCUIT



*Leadless ceramic disc capacitor L1 = 3 turns 0.0 mm enamel, 4 mm dia. L2 = 2 turns 1 mm enamel, 6.5 mm dia.

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

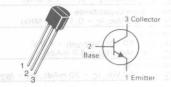


Rating	Symbol	BF 844	BF 845	Unit
Collector-Emitter Voltage	VCEO	400	350	Vdc
Collector-Base Voltage	VCBO	450	400	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current - Continuous	IC	300		mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD PD		.5	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55 to	+150	°C

THERMAL CHARACTERISTICS

Characteristic A ROTO	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _H JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



VOLTAGE TRANSISTORS

NPN SILICON

Refer to MPSA44 for graphs.

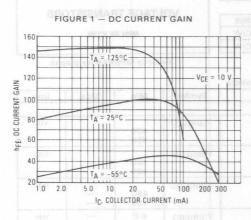
ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted.)

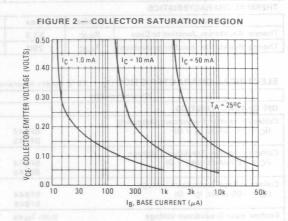
Characteristic	L L OE O E	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	BF844 BF845	V(BR)CEO	400 350		Vdc
Collector-Emitter Breakdown Voltage (IC = 100 μAdc, VBE = 0)	BF844 BF845	V(BR)CES	450 400	8 4	Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	BF844 BF845	V(BR)CBO	450 400	01 0.2 LIC CO	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	Both Types	V(BR)EBO	6.0		Vdc
Collector Cutoff Current (V _{CB} = 400 Vdc, I _E = 0) (V _{CB} = 320 Vdc, I _E = 0)	BF844 BF845	ICBO	_	0.1 0.1	μAdc
Collector Cutoff Current (V _{CE} = 400 Vdc, V _{BE} = 0) (V _{CE} = 320 Vdc, V _{BE} = 0)	BF844 BF845	ICES		500 500	nAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	Both Types	IEBO		0.1	μAdc
ON CHARACTERISTICS					
DC Current Gain (1) (IC = 1.0 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc) (IC = 50 mAdc, VCE = 10 Vdc) (IC = 50 mAdc, VCE = 10 Vdc) (IC = 100 mAdc, VCE = 10 Vdc)	Both Types Both Types Both Types Both Types	hFE	40 50 45 20	200	
Collector-Emitter Saturation Voltage (1) (IC = 1.0 mAdc, IB = 0.1 mAdc) (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)	Both Types Both Types Both Types	VCE (sat)		0.4 0.5 0.75	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)		VBE(sat)		0.75	Vdc

(1) Pulse Test: Pulse Width $\leq 300 \,\mu\text{S}$ — Duty Cycle $\leq 2.0 \,\%$.

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
DYNAMIC CHARACTERISTICS			8	N RATING	UNIXAN
High Frequency Current Gain (IC = 10 mAdc, VCE = 10 Vdc, f = 10 MHz)	Both Types	hfe	2.0	gnite ll	
Collector-Base Capacitance (VCB = 20 Vdc, I _E = 0, f = 1.0 MHz)	Both Types	OBO Cob		6.0	pF
Emitter-Base Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	Both Types	Cib	_	110	pF
Turn-On Time (V _{CC} = 150 Vdc, V _{BE} (off) = 4.0 V, I _C = 30 mAdc, I _{B1} = 3.0 mAdc)	Both Types	of ton	ONUQUE G TA = 25 o		μς otal Divict Denate st
Turn-Off Time (VCC = 150 Vdc, IC = 30 mAdc, IB1 = IB2 = 3.1	Both Types 0 mAdc)	gg toff	@Tc- 25	Dis Of a test	orente at







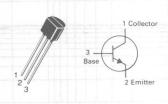
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current - Continuous	IC	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1,5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

VOI TAMH - BF959

CASE 29-04, STYLE 21 TO-92 (TO-226AA)

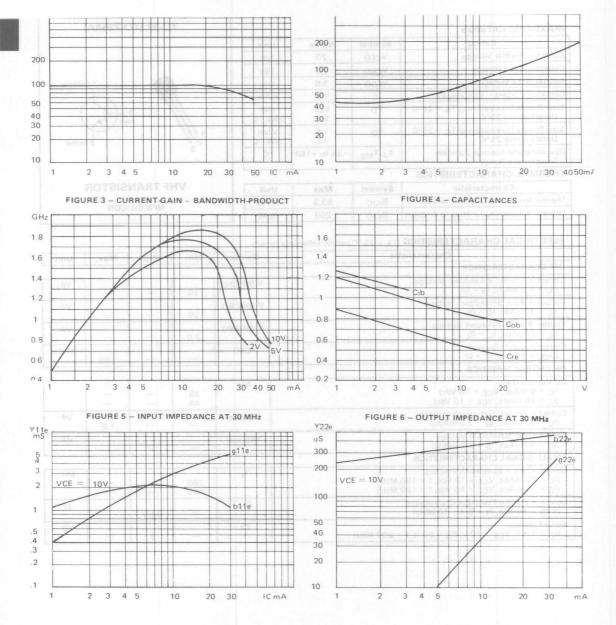


VHF TRANSISTOR

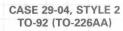
NPN SILICON

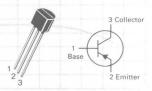
ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

Characteristic	2.1	Symbol	Min.	Тур.	Max.	Unit
OFF CHARACTERISTICS	. ##	++++///		TT		
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	1	V(BR)CEO	20		7	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)		V(BR)CBO	30			Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	an H	V(BR)EBO	3.0			Vdc
Collector Cutoff Current (VCB = 20 Vdc, IE = 0)	20	ІСВО			100	nAdc
ON CHARACTERISTICS						
DC Current Gain (IC = 5 mAdc, VCE = 10 Vdc) (IC = 20 mAdc, VCE = 10 Vdc)	Ar	hee o	35 40	= =	- 8 -	
Collector-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 2.0 mAdc)	Y22a	VCE(sat)	WED ANCE	- INPUT IN	1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 2.0 mAdc)	8v 1	VBE(sat)			1	Vdc
SMALL-SIGNAL CHARACTERISTICS			4			
Current-Gain - Bandwidth Product (IC = 20 mAdc, VCE = 10 Vdc, f = 100 MHz) (IC = 30 mAdc, VCE = 10 Vdc, f = 100 MHz)	ons.	ft	700 600			MHz
Common Emitter Feedback Capacitance (VCB = 10 Vdc, P _f = 0, f = 10 MHz)		Cre	_	0.65'	1	pF
Noise Figure (I _C = 4 mA, V _{CE} = 10 V, R _S = 50 Ω, f = 200 MHz)	0.0	Nf		3		dB



MAXIMUM RATINGS		7 8	
Rating	Symbol	MPS536	Unit
Collector-Emitter Voltage	VCEO	10	Vdc
Collector-Base Voltage	V _{CBO}	15	Vdc
Emitter-Base Voltage	VEBO	4.5	Vdc
Collector Current — Continuous	W IC	30	mA
Power Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Storage Temperature	T _{stg}	-65 to +150	°C



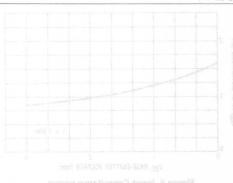


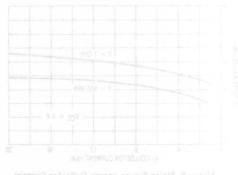
HIGH FREQUENCY TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_C = 25°C *For both package types unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			7.3		Status		
Collector-Emitter Breakdown Voltage (I _C = 2.0	0 mA, IB = 0	8	V(BR)CEO	10		140	Vdc
Collector-Base Breakdown Voltage (IC = 100 /	μA , $I_E = 0$)		V(BR)CBO	15	- GUMAN	1-	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ A,	$I_C = 0$		V(BR)EBO	4.5	-	1 + 1	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E =	0)		ІСВО		3	10	nAdc
ON CHARACTERISTICS		夢					
DC Current Gain (I _C = 20 mA, V _{CE} = 5.0 V)		8	hFE	20		200	_
DYNAMIC CHARACTERISTICS		ii.		Am 03 — 31			
Current Gain-Bandwidth Product (I _C = 20 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 GHz	z)		fŢ	IHI	4.5	-	GHz
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _F = 0, f = 1.0 MHz)			C _{cb}		0.8	1.2	pF
FUNCTIONAL TESTS	ngure a		(Memule)		nime mante		12.6
Gain @ Noise Figure (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	f = 50 f = 1.0		GNF	yanou	14 8.0	=	dB
Noise Figure			NF				dB
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	f = 50 f = 1.0	0 MHz 0 GHz		_	4.5 6.0	_	





Rigure 6, Input Capacitance versus Emitter-Base Voltage Figure 5. Noise Figure versus Collector Current

^{*}Free air

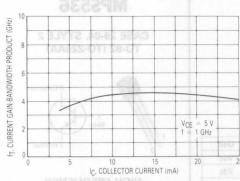


Figure 1. Current Gain-Bandwidth Product versus Collector Current

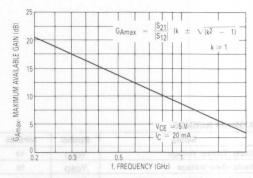


Figure 2. Maximum Available Gain (G_{Amax}) versus Frequency

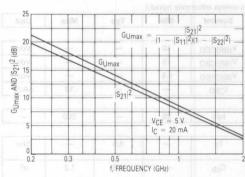


Figure 3. Maximum Unilateral Gain (G_{Umax}) and Insertion Gain (|S₂₁|²) versus Frequency

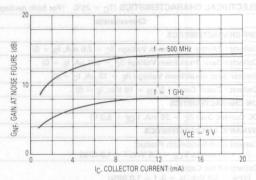


Figure 4. Gain at Noise Figure versus Collector Current

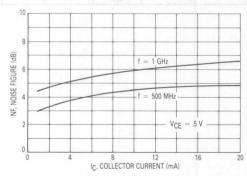


Figure 5. Noise Figure versus Collector Current

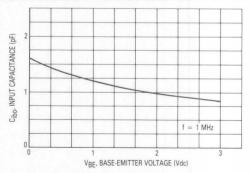


Figure 6. Input Capacitance versus Emitter-Base Voltage

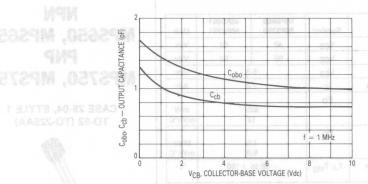
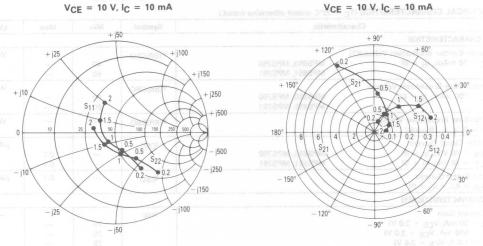


Figure 7. Output Capacitance versus Collector-Base Voltage

INPUT/OUTPUT REFLECTION COEFFICIENT

versus
FREQUENCY
VCE = 10 V, IC = 10 mA

FORWARD/REVERSE
TRANSMISSION COEFFICIENTS
versus
FREQUENCY



COMMON EMITTER S-PARAMETERS

VCE	Ic	f_	S ₁	1	S ₂	1	S ₁₂		200 m	22
(Volts)	(mA)	(MHz)	S ₁₁	Δφ	S ₂₁	∠φ	S ₁₂	∠ φ A	S22	10 Lp
10	°5	200	0.60	-43	6.60	125	0.07	68	0.71	- 35
		500	0.30	- 60	3.64	87	0.14	57	0.47	- 43
bV	81	1000	0.17	- 103	2.11	56	0.22	43	0.32	- 69
		1500	0.15	156	1.70	28	0.30	28	0.22	a 0 + 112
		2000	0.28	110	1.29	2	0.33	13	0.25	- 174
	10	200	0.48	- 52	8.78	118	0.06	69	0.62	-42
HJM		500	0.21	-66	4.31	84	0.12	60	0.37	- 46
		1000	0.12	-122	2.40	54	0.20	47	0.24	-73
		1500	0.18	138	1.90	29	0.29	31	0.16	- 126
		2000	0.32	104	1.41	e of 4 feloos	0.33	16	0.23	170
	20	200	0.38	- 59	10.21	112	0.06	70	0.54	- 46
		500	0.14	-76	4.72	81	0.12	63	0.30	- 47
		1000	0.11	- 144	2.58	53	0.20	49	0.19	-74
		1500	0.22	132	1.99	28	0.29	34	0.12	- 139
		2000	0.35	103	1.46	4	0.33	19	0.22	161

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Conector-Emitter voltage	VCE	40	60	vac
Collector-Base Voltage	VCB	60	80	Vdc
Emitter-Base Voltage	VEB		5.0	Vdc
Collector Current — Continuous	Ic		2.0	Adc
Total Power Dissipation @ TA = 25°C Derate above 25°C	PD		525 12	mW mW/°C
Total Power Dissipation @ T _A = 25°C Derate above 25°C	P _D		1.5 5.0	Watt mW/°0
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 t	to +150	°C

THERMAL CHARACTERISTICS

THERMAL CHARACTERISTICS		it Capacitan -Bese Volta	
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

PNP MPS750, MPS751

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

FREQUENCY $V_{CE} = 10 \text{ V, } I_C = 10 \text{ mA}$

N. L. L. C.		Cha	racteristic				Symbol	Min	Max	Unit
OFF CHARAC	CTERISTICS	08 +						1		
	itter Breakdow nAdc, I _B = 0)	n Voltage(1	MPS	650, MPS750 651, MPS751		90n	V(BR)CEO	40 60	X =	Vdc
	se Breakdown \u2214 \u2214Adc, IE = 0)	Voltage		650, MPS750 651, MPS751		M	V(BR)CBO	60 80	7=7	Vdc
	Breakdown Vo = 10 μAdc)	oltage		roas		R	V(BR)EBO	5.0	1 -	Vdc
	off Current Vdc, I _E = 0) Vdc, I _E = 0)	B		650, MPS750 651, MPS751		倒	ІСВО	-	0.1 0.1	μAdo
Emitter Cuto (V _{EB} = 4.0	ff Current O V, I _C = 0)			Year .		0811	IEBO	/^\	0.1	μAdd
ON CHARAC	TERISTICS(1)		XX			7	A			
$(I_C = 500)$ $(I_C = 1.0)$	Gain nA, V _{CE} = 2.0 mA, V _{CE} = 2.0 A, V _{CE} = 2.0 V A, V _{CE} = 2.0 V) V))	2927			DUTE DECRETA	hFE	75 75 75 40	Sign	_
$(I_C = 2.0 A)$	itter Saturation A , $I_B = 200 \text{ m/s}$ A , $I_B = 100 \text{ m/s}$	()	Silver	The state of	52	10.3	VCE(sat)	+t (±HW)	0.5	Vdc
Base-Emitter		88	0.07	125	6.60	-43	V _{BE(on)}	200-	1.0) Vdc
	Saturation Vo A, I _B = 100 mA		0.30	56 28	2.13	-103 156	V _{BE(sat)}	0001 1600	1.2	Vdc
SMALL-SIGN	IAL CHARACTE	RISTICS	£6.U		CX.1	913	86.0	0005		
	— Bandwidth Adc, V _{CE} = 5		100 MHz)	84	4.31	- 88 -	fT _{15.0}	75	1 1 41	MHz
	Pulse Width sed as the frequen				nity.	138 - 104	0.18 0.32	1500		

FIGURE 1 — MPS650, MPS651

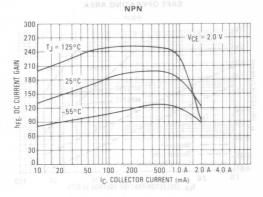


FIGURE 2 — MPS750, MPS751 TYPICAL DC CURRENT GAIN

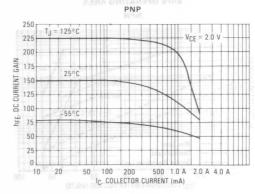


FIGURE 3 - MPS650, MPS651 ON VOLTAGES

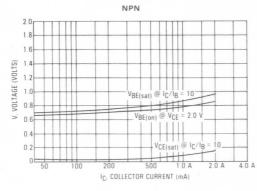


FIGURE 4 - MPS750, MPS751 ON VOLTAGES

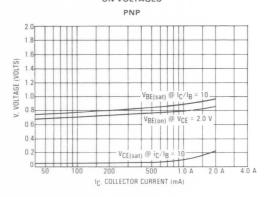


FIGURE 5 — MPS650, MPS651 COLLECTOR SATURATION REGION

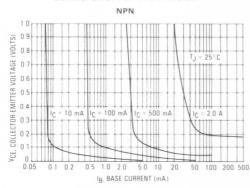


FIGURE 6 — MPS750, MPS751 COLLECTOR SATURATION REGION

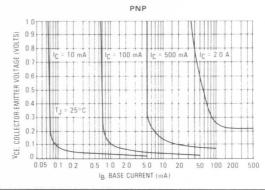


FIGURE 7 — MPS650, MPS651 SOA, SAFE OPERATING AREA

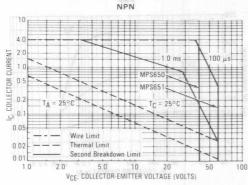
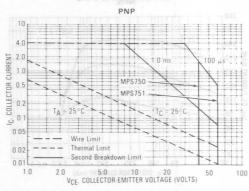
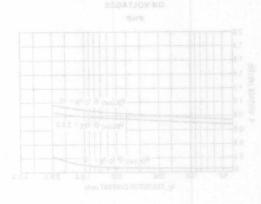
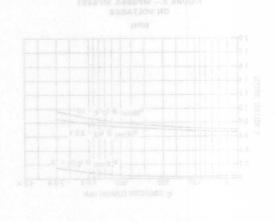
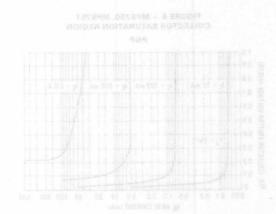


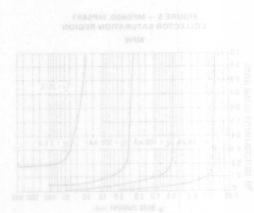
FIGURE 8 — MPS750, MPS751 SOA, SAFE OPERATING AREA









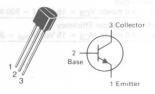


Rating	Symbol	MPS918	MPS3563	Unit
Collector-Emitter Voltage	VCEO	15	12	Vdc
Collector-Base Voltage	VCBO	30	30	Vdc
Emitter-Base Voltage	VEBO	3.0	2.0	Vdc
Collector Current — Continuous	Ic	806	50 °M	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	₩ PD		25	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) $(I_C = 3.0 \text{ mAdc}, I_B = 0)$	MPS918 MPS3563	V(BR)CEO	15 12	=	Vdc
Collector-Base Breakdown Voltage (IC = 1.0 μ Adc, IE = 0) (IC = 100 μ Adc, IE = 0)	MPS918 MPS3563	V(BR)CBO	30 30	_	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	MPS918 MPS3563	V _{(BR)EBO}	3.0 2.0	_	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)	MPS918 MPS3563	ICBO	_	10 50	nAdo
ON CHARACTERISTICS					
DC Current Gain(2) (IC = 3.0 mAdc , VCE = 1.0 Vdc) (IC = 8.0 mAdc , VCE = 10 Vdc)	MPS918 MPS3563	hFE	20 20	 200	_
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$)	MPS918	VCE(sat)	_	0.4	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$)	MPS918	V _{BE(sat)}	_	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz) (I _C = 8.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	MPS918 MPS3563	fT	600 600	 1500	MHz
Output Capacitance $(V_{CB} = 0 \text{ Vdc}, I_E = 0, f = 140 \text{ kHz})$ $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 140 \text{ kHz})$ $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$	MPS918 MPS918 MPS3563	C _{obo}	=	3.0 1.7 1.7	pF
Input Capacitance ($V_{EB} = 0.5 \text{ Vdc}$, $I_{C} = 0$, $f = 140 \text{ kHz}$)	MPS918	C _{ibo}	_	2.0	pF
Small-Signal Current Gain ($I_C = 8.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	MPS3563	h _{fe}	20	250	_
Noise Figure $(I_C = 1.0 \text{ mAdc}, V_{CE} = 6.0 \text{ Vdc}, R_S = 400 \text{ ohms}, f = 60 \text{ MHz})$	MPS918	NF	_	6.0	dB

⁽¹⁾ R $_{\theta,JA}$ is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 1.0%.

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit		
FUNCTIONAL TEST					RATINGS	MAXIMITA
Common-Emitter Amplifier Power Gain	nerta E	MPS918 MPS35A	Gpe		gniteEl	dB
$(I_C = 6.0 \text{ mAdc}, V_{CB} = 12 \text{ Vdc}, f = 200 \text{ MHz})$		MPS918	OSOV 1	15	egatio7 rost	Collector
$(I_C = 8.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 200 \text{ MHz})$ $(G_{fd} + G_{re} < -20 \text{ dB})$		MPS3563	VCBO	14	epatov se	il-10 toslib
Power Output	Vdc	3.0 2.0	OliPout	30	e <u>se</u> tioV	mW
$(I_C = 8.0 \text{ mAdc}, V_{CB} = 15 \text{ Vdc}, f = 500 \text{ MHz})$	nsAcjo	MPS918	al J	decina	rent Conli	Collector
Oscillator Collector Efficiency (IC = 8.0 mAdc, V _{CB} = 15 Vdc, P _{out} = 30 mW,	f = 500 MHz)	MPS918	σ9 η	25 _A T 3	Dissipation &	de elste0
Base				at Doy ce Dissipation @ Tg = 25°C erate above 25°C		
AMPLIFIER TRANSISTOR						
New Siricon		8.6791				
			DUAR			

INALL-LONAL CHARACTERISTICS			
urrant-fush — 8 mowidth Product(2) (IC = 4.0 mAdc, Vgg = 10 Vdc, f = 100 MHz) (IC = 1.0 mAdc, Vgg = 10 Vdc, f = 100 MHz)			

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Miles Dilling	ladmyič	-		
Rating	Symbol	MPS929	MPS930A	Unit
Collector-Emitter Voltage	VCEO	9	45	Vdc
Collector-Base Voltage	VCBO	45	60	Vdc
Emitter-Base Voltage	VEBO	5.0	6.0	Vdc
Collector Current — Continuous	IC	100		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 c 29 M		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

B-DF X Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS930A

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPS3903 for additional graphs.

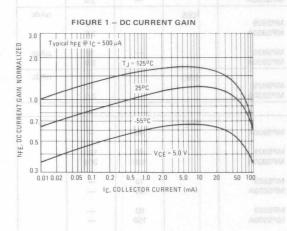
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	onordena.		alov n.a	Le net oblig	negri si
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	WPS930A	V(BR)CEO	45	ohms , f = 10	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	MPS929 MPS930A	V(BR)CBO	45 60	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	MPS929 MPS930A	V(BR)EBO	5.0 6.0	_	Vdc
Collector Cutoff Current (V _{CE} = 5.0 Vdc, I _B = 0)		ICEO	_	2.0	nAdd
Collector Cutoff Current (V _{CB} = 45 Vdc, I _E = 0)	MPS929 MPS930A	ICBO	_	10 2.0	nAdo
Collector Cutoff Current (V _{CE} = 45 Vdc, V _{BE} ≠ 0) 10 V 100" - 2 38 UDI	MPS929 MPS930A	ICES	DC CURRE	2.0	nAdd
$(V_{CE} = 45 \text{ Vdc}, V_{BE} = 0, T_{A} = 125^{\circ}\text{C})$	MPS929 MPS930A		350 00 - 17	10 2.0	μAdd
Emitter Cutoff Current (V _{EB} = 5.0 Vdc, I _C = 0)	MPS929 MPS930A	IEBO		10 2.0	nAdd
ON CHARACTERISTICS	10 7001362				
DC Current Gain(1) (I _C = 1.0 μ Adc, V _{CE} = 5.0 Vdc)	MPS930A	hFE	60		1
(I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	MPS929 MPS930A	- 50 V	40 100	120 300	
$(I_C = 10 \mu Adc, V_{CE} = 5.0 \text{ Vdc}, T_A = -55^{\circ}\text{C})$	MPS929 MPS930A	D S. O. D.S. O. RENT (H)A)	10	0.02	
(I _C = 500 μ Adc, V _{CE} = 5.0 Vdc)	MPS929 MPS930A		60 150	=	
(I _C = 10 mAdc, V_{CE} = 5.0 Vdc)	MPS929 MPS930A		_	350 600	

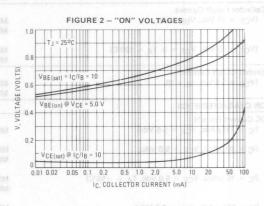
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

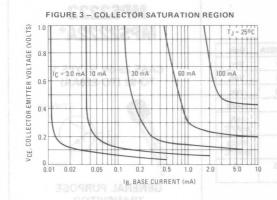
Characteristic			Symbol	Min	Max	Unit
Collector-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 0.5 mAdc)	Unit	MPS929 MPS930A	VCE(sat)		1.0 0.5	Vdc
Base-Emitter Saturation Voltage(1) (IC = 10 mAdc, Ig = 0.5 mAdc)	Vde Vae	MPS929 MPS930A	V _{BE} (sat)	0.6 0.7	1.0	Vdc Vdc
SMALL-SIGNAL CHARACTERISTICS	OBART	801	3	8000/	alloy - ms	TE A TOTOGRADIO
Current-Gain — Bandwidth Product (IC = 500 μ Adc, VCE = 5.0 Vdc, f = 30 MHz)	Www. Study Study	MPS929 MPS930A	ीं वि	30 45	o de la la la la la la la la la la la la la	MHz
Output Capacitance $(VCB = 5.0 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$	Or Own	MPS929 MPS930A	Cobo		8.0 6.0	pF na gnilateqC tot magnitut
Input Impedance (I _E = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)			h _{ib}	25	32	Ohms
Voltage Feedback Ratio (I _E = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	SHOU WHOM	seld .	h _{rb}	lid	600	X 10-6
Small-Signal Current Gain (IC = 1.0 mAdc, VCE = 5.0 Vdc, f = 1.0 kHz)	WO	MPS929 MPS930A	Ala hfe	60 150	350 600	hannel Rest
Output Admittance (I _E = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)		i balon esiwherbo za	h _{ob}	ERISTICS (T	1.0	μmho
Noise Figure (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 kohms, f = 10 Hz to 15.7 kHz)		MPS929 MPS930A	NF	(Flegs <u>ilo</u> V nw	4.0 3.0	m inercello

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

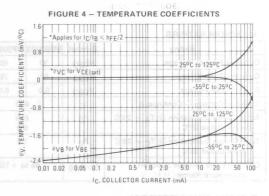
TYPICAL CHARACTERISTICS

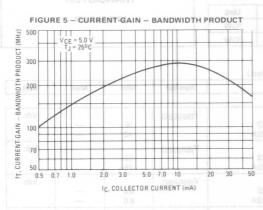


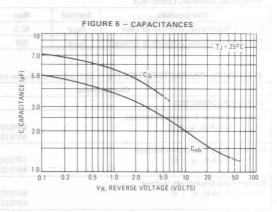




MPS929, MPS930A









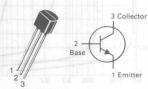
Rating	Symbol	MPS2222	MPS2222A	Unit
Collector-Emitter Voltage	VCEO	30	40	Vdc
Collector-Base Voltage	VCBO	60	75	Vdc
Emitter-Base Voltage	VEBO	5.0	6.0	Vdc
Collector Current — Continuous	Ic	600		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS2222A*

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

INCHAR - MINNEN SILICON - a MAL DIR

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	- 102 B 1-1-				114
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, I _B = 0)	MPS2222 MPS2222A	V(BR)CEO	30 40	=	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	MPS2222 MPS2222A	V(BR)CBO	60 75		Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	MPS2222 MPS2222A	V(BR)EBO	5.0 6.0	=	Vdc
Collector Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	MPS2222A	CEX	_	10	nAdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 125°C) (V _{CB} = 50 Vdc, I _E = 0, T _A = 125°C)	MPS2222 MPS2222A MPS2222 MPS2222A	Ісво	=	0.01 0.01 10	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)	MPS2222A	IEBO	_	10	nAdc
Base Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	MPS2222A	IBL	-	20	nAdc
ON CHARACTERISTICS					
DC Current Gain $ \begin{aligned} &(IC = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(IC = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(IC = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(IC = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(IC = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(IC = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(IC = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}) \\ &(IC = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(IC = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ \end{aligned} $	MPS2222A only MPS2222 MPS2222A	hFE	35 50 75 35 100 50 30 40	300	_
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	MPS2222 MPS2222A	VCE(sat)	=	0.4	Vdc
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$	MPS2222 MPS2222A		_	1.6 1.0	

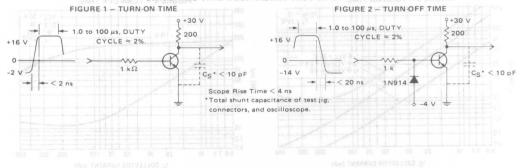
^{*}Also available as a PN2222,A.

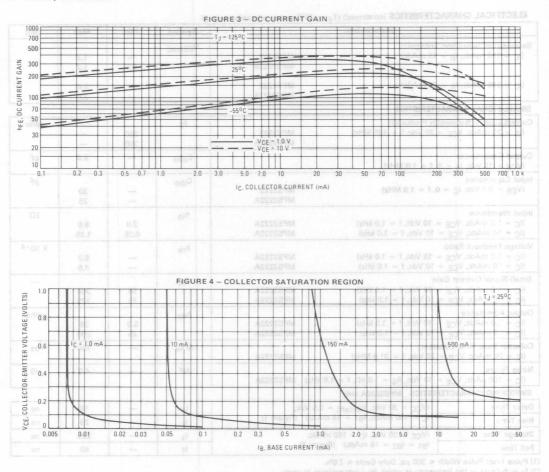
And the second second second		and the second state of the second	оунноп	IAIIU	iviax	Unit
Base-Emitter Saturation Volta (IC = 150 mAdc, I _B = 15 m		MPS2222 MPS2222A	V _{BE} (sat)	0.6	1.3 1.2	Vdc
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ n})$	nAdc)	MPS2222 MPS2222A			2.6 2.0	
SMALL-SIGNAL CHARACTER	ISTICS	- F H- F- 5088				- n
Current-Gain — Bandwidth P (I _C = 20 mAdc, V _{CE} = 20		MPS2222 MPS2222A	fT	250 300		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f =	1.0 MHz)		C _{obo}		8.0	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MHz) MPS2222 MPS2222A		C _{ibo}	=	30 25	pF	
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 10 (I _C = 10 mAdc, V _{CE} = 10		MPS2222A MPS2222A	h _{ie}	2.0 0.25	8.0 1.25	kΩ
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 (I _C = 10 mAdc, V _{CE} = 10		MPS2222A MPS2222A	h _{re}	=	8.0 4.0	X 10-4
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) MPS2222A (I _C = 10 mAdc, V _{CF} = 10 Vdc, f = 1.0 kHz) MPS2222A MPS2222A		- I Bauhfe	50 75	300 375		
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 (I _C = 10 mAdc, V _{CE} = 10		MPS2222A MPS2222A	h _{oe}	5.0 25	35 200	μmhos
Collector Base Time Constant (I _E = 20 mAdc, V _{CB} = 20		MPS2222A	rb'C _C		150	ps
Noise Figure (I _C = 100 μ Adc, V _{CE} = 10 Vdc, R _S = 1.0 k Ω , f = 1.0 kHz) MPS2222A		NF		4.0	dB	
SWITCHING CHARACTERIST	ICS MPS2222A only					
	$(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc},$ $I_{C} = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc}) \text{ (Figure 1)}$		td		10	ns
Rise Time			t _r		25	ns
	$I_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ m}$ $I_{B1} = I_{B2} = 15 \text{ mAdc}) (Fig$		t _S	60.00_ 20.0	225 60	ns

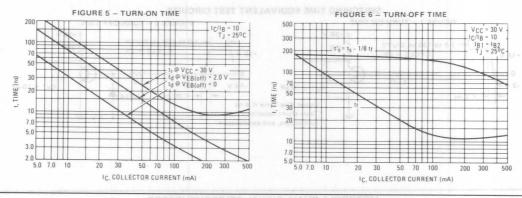
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) f_T is defined as the frequency at which |h_{fe}| extrapolates to unity.

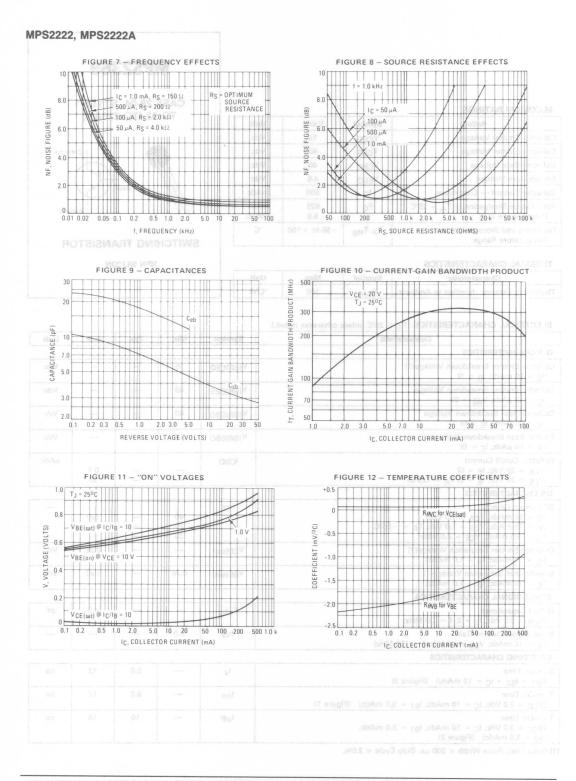
SWITCHING TIME EQUIVALENT TEST CIRCUITS







MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



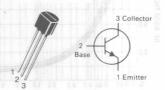
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Emitter Voltage	VCES	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.5	Vdc
Collector Current — Continuous	IC	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Operating and Storage Junction	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS2369

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



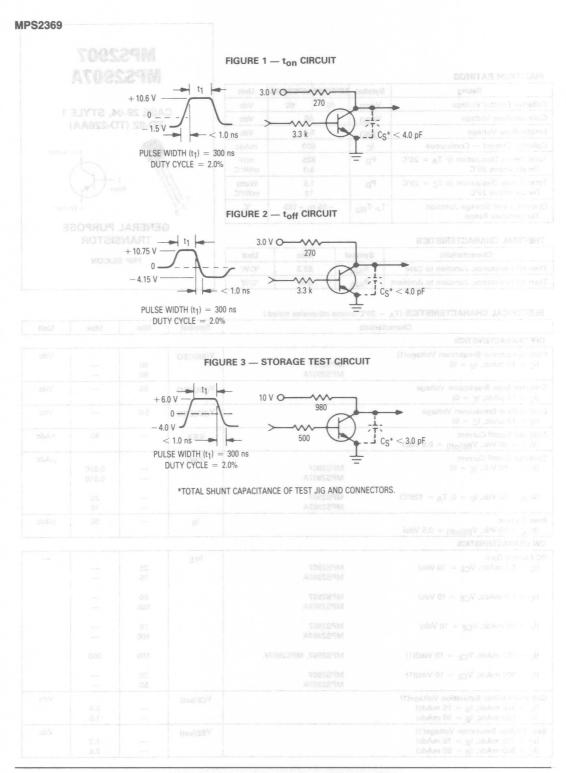
SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					Le B
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, Ig = 0)	V(BR)CEO	15	1 1		Vdc
Collector-Emitter Breakdown Voltage (I _C = 10 μAdc, V _{BE} = 0)	V(BR)CES	40	-		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	40		Eli Su	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V _{(BR)EBO}	4.5	av sa ns van	_	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0) (V _{CB} = 20 Vdc, I _E = 0, T _A = 125°C)	СВО	SALIOV	"MO <u>" -</u> 71	0.4	μAdd
ON CHARACTERISTICS				The second	191
DC Current Gain(1) (IC = 10 mAdc, V _{CE} = 1.0 Vdc) (IC = 10 mAdc, V _{CE} = 1.0 Vdc, T _A = -55°C) (IC = 100 mAdc, V _{CE} = 2.0 Vdc)	hFE	40 20 20	-01	120 —	0.0
Collector-Emitter Saturation Voltage(1) (IC = 10 mAdc, IB = 1.0 mAdc)	VCE(sat)	-	y or .	0.25	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc)	VBE(sat)	0.70		0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS					0.2
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	Cobo		- nr =	4.0	pF
Small-Signal Current Gain (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	hfe	5.0	o 2 <u>n</u> sio	(1.5)1	0 —
SWITCHING CHARACTERISTICS					
Storage Time $(I_{B1} = I_{B2} = I_C = 10 \text{ mAdc})$ (Figure 3)	t _s		5.0	13	ns
Turn-On Time ($V_{CC}=3.0~V_{dc}, I_{C}=10~mAdc, I_{B1}=3.0~mAdc)$ (Figure 1)	ton	-	8.0	12	ns
Turn-Off Time $(V_{CC} = 3.0 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = 3.0 \text{ mAdc}, I_{B2} = 1.5 \text{ mAdc})$ (Figure 2)	toff	-	10	18	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

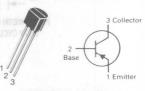
Rating	Symbol	MPS2907	MPS2907A	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Base Voltage	Vсво	MA	60	Vdc
Emitter-Base Voltage	VEBO	2	5.000	Vdc
Collector Current — Continuous	Ic	600		mAdc
Total Device Dissipation @ $T_A = 25^{\circ}C$ Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55	to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS2907A

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

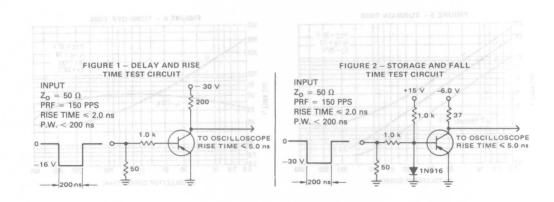
Character	istic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	MPS2907 MPS2907A	V(BR)CEO	40 60	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	O V 51	V _(BR) CBO	60	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	5.0		Vdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{BE(off)} = 0.5 Vdc)		ICEX	-	50	nAdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)	MPS2907 MPS2907A	CBO	1 =	0.020 0.010	μAdc
$(V_{CB} = 50 \text{ Vdc}, I_{E} = 0, T_{A} = 125^{\circ}\text{C})$	MPS2907 MPS2907A	-1019F SHINELD	Ξ	20 10	
Base Current (V _{CE} = 30 Vdc, V _{BE(off)} = 0.5 Vdc)		IB		50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 0.1 mAdc, V_{CE} = 10 Vdc)	MPS2907 MPS2907A	hFE	35 75	=	_
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPS2907 MPS2907A		50 100	=	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPS2907 MPS2907A		75 100	Ξ	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	MPS2907, MPS2907A		100	300	
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	MPS2907 MPS2907A		30 50	=	
Collector-Emitter Saturation Voltage(1) ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)		VCE(sat)	=	0.4 1.6	Vds
Base-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)		VBE(sat)	Ξ	1.3 2.6	Vdc

ELECTRICAL CHARACTERISTICS (continued) (Ta = 25°C unless otherwise noted.)

	Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CH	ARACTERISTICS				55
	dwidth Product(1),(2) CE = 20 Vdc, f = 100 MHz)	fT	200	1 1 81	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E	er COR Ann DET (C _{obo}	Ad 0.	= 31 8.0	pF
Input Capacitance (VBE = 2.0 Vdc, Ic	c = 0, f = 1.0 MHz)	C _{ibo}		30	pF
SWITCHING CHARA	CTERISTICS	- II IA-I		AHH	9
Turn-On Time		ton		45	ns
Delay Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc, I _{R1} = 15 mAdc) (Figures 1 and 5)	t _d		10	ns
Rise Time	IBI = 10 III/de/ (Figures 1 died)	t _r		40	ns
Turn-Off Time	02 03 03 03 03 03 03 03 03 10 30 20	toff	SW10 20.0	100	ns
Storage Time	(V _{CC} = 6.0 Vdc, I _C = 150 mAdc,) THERRIF SCAR (I I _{B1} = I _{B2} = 15 mAdc) (Figure 2)	t _S	_	80	ns
Fall Time	101 - 107 - 10 History (Highlory)	tf	_	30	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

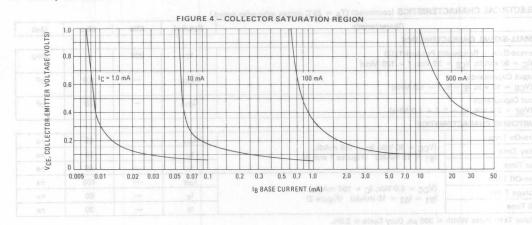
(2) f_T is defined as the frequency at which |h_{fe}| extrapolates to unity.

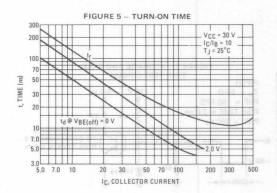


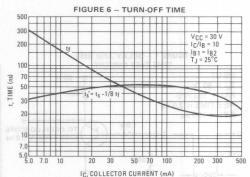
TYPICAL CHARACTERISTICS

FIGURE 3 - DC CURRENT GAIN NORMALIZED CURRENT GAIN 25°C 1.0 0.7 hFE, 0.3 0.2 0.1 0.2 0.3 0.5 0.7 1.0 2.0 3.0 5.0 7.0 10 50 70 100 200 300 IC, COLLECTOR CURRENT (mA)

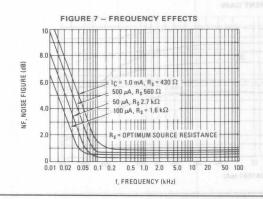
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

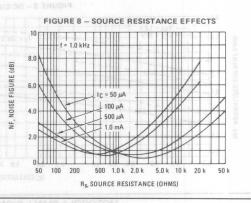




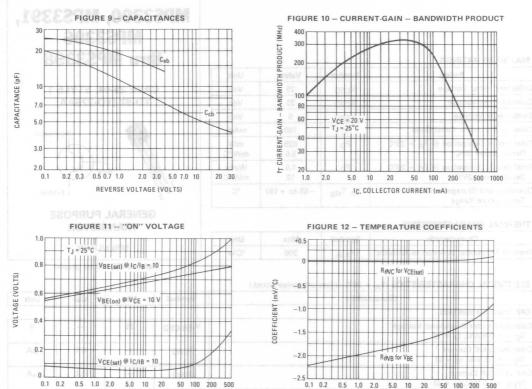


TYPICAL SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE $V_{CE} = 10 \ Vdc, \ T_A = 25^{\circ}C$





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





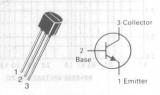
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	25	Vdc
Emitter-Base Voltage	VEBO	5	Vdc
Collector Current — Continuous	Ic	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS3390, MPS3391, MPS3396 thru MPS3398

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3903 for graphs.

1250

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	6			
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	25		V
Collector Cutoff Current ' (VCB = 18 Vdc, IE = 0)	Ісво	= SF(3) = (62)3	0.1	μΑ
Emitter Cutoff Current (VEB = 5.0 Vdc, IC = 0)	IEBO	0/ 0.8 0.5	0.1	μΑ
ON CHARACTERISTICS (Am) TRANSPORTOR LINE (2)	(Am) Tit3	LLECTOR EURR	10,50	
MI MI MI	PS3390 PS3391 PS3396 PS3396 PS3397 PS3398	400 250 90 55 55	800 500 500 500 800	_
SMALL-SIGNAL CHARACTERISTICS			ATT I I I	
Output Capacitance ($V_{CB} = 10 \text{ V}$, $I_{E} = 0$, $f = 1.0 \text{ MHz}$)	C _{obo}	-	10	pF
M	PS3390 PS3391 PS3396 PS3397	400 250 90 55	1250 800 800 800	_

MPS3398

MAXIMON NATINGS			
Rating 8-83 HSAO	Symbol	Value	00 Unit
Collector-Emitter Voltage	VCEO	obV 25	0 Vdc
Collector-Base Voltage	VCBO	sby 25	0.8 Vdc
Emitter-Base Voltage	VEBO	abAm5.0	Vdc
Collector Current — Continuous	IC	Wm 500	asa mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	ansW1.5	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	er e°C−

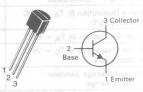
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	000°C/W

MPS3403

JUDD For Specifications, See MI 5918 Data

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



TRANSISTOR

NPN SILICON

Refer to MPS8098 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) pasto application of the pasto

acteristic	Symbol	Min	Max	Unit
			CLENZLICS	METHOD I
V(BR)CEO(sue	V(BR)CEO	25	tter P <u>re</u> akdo (A)	Vdc
080(88) ^V	V(BR)CBO	25	e Bre <u>sk</u> dows uA)	Vdc
ова(яв)У	V _{(BR)EBO}	5.0		Vdc
lcao.	ІСВО	= 6	100 V	nA
0831	IEBO	-		nA
			TEMSTICS	CHARAC
944	hFE	180		
Hea)EOV	VCE(sat)	v) n Voltage		
VBElon	V _{BE} (sat)	0.6		
		(V 0	I P 30V PH	FUEL TO
dz) odso	h _{fe}	75	_eons!	REGAL CARRES
	V(BR)EBO ICBO IEBO IEBO NFE VGE(est)	OB3(RB)V V(BR)CBO OB3(RB)V V(BR)EBO ICBO ICBO IEBO VCE(sat) VCE(sat) VBE(sat) Italian Inchast	V(BR)CBO 25 V(BR)CBO 5.0 V(BR)EBO 5.0 ICBO — IEBO — VCE(sat) VEE(sat) VBE(sat) VBE(sat) VBE(sat) VBE(sat) VBE(sat) VBE(sat) VBE(sat)	V(BR)CBO 25 V(BR)CBO 5.0

namy	Symbol	value	Unit
Collector-Emitter Voltage	VCEO	sinU 30	Vdc
Collector-Base Voltage	VCBO	shV 40	Vdc
Emitter-Base Voltage	VEBO	5.0 Vdc	Vdc
Collector Current — Continuous	Ic	55V 200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Power Dissipation @ TA = 60°C	PD	450	0.8 mW
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2116W1.5 37Wm12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	of 8°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	R _θ JA	200	°°C/W

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N4400 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

sintle stated solly Char	acteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				SOUTENEET	F CHARAC
Collector-Emitter Breakdown Voltage(1) (I _C = 30 mA)	V(BR)CEO.	V(BR)CEO(sus)	30 V AV	iter E <u>rreakdo</u> A)	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μA)	ОвојнајУ	V(BR)CBO	40	Bre <u>ak</u> down A)	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA)	ованяву	V(BR)EBO	5.0	nwo <u>lo</u> isans ()	Vdc
Collector Cutoff Current (V _{CB} = 20 V) (V _{CB} = 20 V, T _A = 75°C)	060	ІСВО	_ (0)	50 5.0	nA μA
Emitter Cutoff Current (VBE = 5.0 V)		IEBO	-	10 10	μΑ
ON CHARACTERISTICS				EARITICS	CHARAGO
DC Current Gain (I _C = 10 mA, V _{CE} = 10 V) (I _C = 2.0 mA, V _{CE} = 10 V)	39/1	hFE	150	600 A	
Collector-Emitter Saturation Voltage (I _C = 100 mA, I _B = 10 mA)	(988)304	VCE(sat)	lAc	V molterurs	Vdc
Base-Emitter On Voltage(1) (I _C = 100 mA, V _{CE} = 1.0 V)	1100000	V _{BE} (on)	A) (A)	10.E 0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	and The second			Jurrent Gain	lar gi8-li
Output Capacitance (V _{CB} = 10 V, f = 1.0 MHz)		C _{obo} (si	10.1 = 1.0 i 10.1 = 1.0 i	.b = 25 V .A .b = ∃0V .A	
Small-Signal Current Gain (IC = 30 mA, VCE = 10 V, f = 20 MH	łz)	h _{fe}	2.0	35	_

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

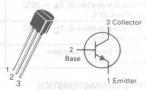
Rating	Symbol	MPS3567 MPS3569	MPS3568	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Base Voltage	VCBO	8	0	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	600		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	3 7 6	25	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	35Wm1		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _Ø JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS3567 MPS3568 MPS3569

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N4400 for graphs for MPS3567, 3569.*

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) Herrita passing DISS = ATI SOTTEMATORISTORIST LACE HERE TO A FIRST CONTROL OF THE PROPERTY OF T

	Symbol	Min	Max	Unit
		VISITED AND TO SERVICE AND THE PERSON NAMED AND THE	CTERISTICS	ARAHO 130
MPS3567, MPS3569 MPS3568	VCEO(sus)	40 60	obstem3 vette uAdo 786 =	Vdc 1
	V(BR)CBO	80	oAdo, 1g = 0	Vdc
	V(BR)EBO	5.0	0 = gt-obAu	Vdc
	ICBO	=	50 5.0	nAdc μAdc
	I _{EBO}	0, T _A — —6	25	nAdc
			(0 = 5LV)	lå jegil
MPS3567, MPS3568 MPS3569	hFE	40 100	Vdc. V ge =	nest al ia Bi = 30 WWARO - W
MPS3567, MPS3568 MPS3569		40 100	120 300	
MPS3038	VCE(sat)	(56V 07	0.25	Vdc
MESSES	VBE(sat)	(abV 6.1	1.1 = 30V .5bAr	Vdc
MPSasaaA				
MPS3638 MPS3638A	fT	60 0.5	mAdc. V _{CE} v	MHz
	C _{obo}	agaRoV Ac	20 1911	pF
	C _{ibo}			pF
	MPS3568 MPS3567, MPS3568 MPS3569 MPS3567, MPS3568 MPS3569	MPS3567, MPS3569 MPS3568 V(BR)CBO V(BR)EBO ICBO IEBO MPS3567, MPS3568 MPS3569 MPS3569 MPS3569 MPS3569 VCE(sat) VBE(sat) TT Cobo	MPS3567, MPS3569 MPS3568 V(BR)CBO V(BR)EBO V(BR)EBO ICBO IEBO MPS3567, MPS3568 MPS3569 MPS369 MPS3569 MPS369 MPS369 MPS369 MPS369 MPS369 MPS36	MPS3567, MPS3569 MPS3568 V(BR)CBO V(BR)EBO V(BR)EBO So ICBO ICBO IEBO MPS3567, MPS3568 MPS3569 MPS3669 MPS3569

*Refer to MPS8098 for graphs for MPS3568.

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Emitter Voltage	VCES	25	Vdc
Collector-Base Voltage	VCBO	25	Vdc
Emitter-Base Voltage	VEBO	40	Vdc
Collector Current — Continuous	Ic	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C 01 88

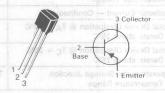
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) R_{BJA} is measured with the device soldered into a typical printed circuit board.

MPS3638 MPS3638A

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N4402 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Sald Nell MAL Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CONSTROL	OFF CHARA
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)	(aba)OBOV	MPSSSS7, MPSSSSS	V(BR)CES	25 / 97	iliter <u>So</u> stain Ado, ig = 0	Vdc
Collector-Emitter Sustaining Voltage(1 (I _C = 10 mAdc, I _B = 0) ,	Овонају	вросечи	VCEO(sus)	25 apsiloV n	se Bregkdow	Vdc ss otosilo.
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	O83(88)¥		V(BR)CBO	25 apartoV	e si abes Braskdown	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)	leso		V(BR)EBO	4.0	to in Dr. John Or To in Ordinate in Ordina	Vdc
Collector Cutoff Current (VCE = 15 Vdc, VBE = 0)	-00		ICES	TA = 76°C	0.035	μAdc
$(V_{CE} = 15 \text{ Vdc}, V_{BE} = 0, T_{A} = -6)$ Emitter Cutoff Current $(V_{EB} = 3.0 \text{ V, I}_{C} = 0)$	5°C) G89		IEBO	10	35	nA
Base Current (V _{CE} = 15 Vdc, V _{BE} = 0)	394	MPS3567, MPS3868	IB	1.0 Vde)	0.035	μAdc
ON CHARACTERISTICS(1)		WIL 2 2003				
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc)		MPS3638A	hFE	(sbV 0.f = 80	mAde, VCE	(lo= 150
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$		MPS3638 MPS3638A		20	itter Saturat mAdo, lg =	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		MPS3638 MPS3638A			Saturation MAde_18 =	G31 = 3 /1
$(I_C = 300 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc})$		MPS3638 MPS3638A	IsHM 05	100010000000000000000000000000000000000	nede <u>V</u> oe Ade <u>Voe</u> =	isE-Inemul
Collector-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 2.5 mAdc)	ode9		VCE(sat)	(514)	0.25	Vdc
$(I_C = 300 \text{ mAdc}, I_B = 30 \text{ mAdc})$	660			_		растей тикра
Base-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 2.5 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)			V _{BE(sat)}		1.1 9083 1.1 9083 1.1 9083	Vdc

MPS3638, MPS3638A

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

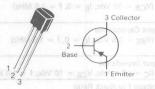
0.824	Char	racteristic		Symbol	Min	Max	Unit
SMALL-SIGNAL CHARA	ACTERISTICS					A PATINGS	IDARXAM
Current-Gain — Bandwi	idth Product		Value Unit	foldowed f _T		priinfi	MHz
(V _{CE} = 3.0 Vdc, I _C =	50 mAdc, f = 1	00 MHz)	MPS3638 MPS3638A	035V	100 150	inter Voltage	iBron. S
Output Capacitance	Orth Merch		30V N	C _{obo}	Maria de la companya	ASSULON AS	pF
(V _{CB} = 10 Vdc, I _E =	0, f = 1.0 MHz)		MPS3638 MPS3638A	Oesv J	= counti	20 10	C-rature to
nput Capacitance				Cibo	@ TA = 257	nottsgissi 🖰	pF
(V _{BE} = 0.5 Vdc, I _C =	0, f = 1.0 MHz)		MPS3638 MPS3638A	- Day	rac = at o	65 25	de entri
nput Impedance (I _C = 10 mAdc, V _{CE}	= 10 Vdc, f = 1.	.0 kHz)		h _{ie}	- noine	2000	Ohms
Voltage Feedback Ratio)			h _{re}		and Range	X 10-4
(I _C = 10 mAdc, V _{CE}	= 10 Vdc, f = 1.	.0 kHz)	MPS3638 MPS3638A		sear Tours	26 15	KKS ACIAL
Small-Signal Current G			statt d coke	hfe h	ale.	beit money of the	-
$(I_C = 10 \text{ mAdc}, V_{CE})$	= 10 Vdc, f = 1.	.0 kHz)	MPS3638 MPS3638A	symper mass	25	Charactes	LG LL T
Output Admittance				421,037	100 0 0	THE REPORTED IN	of week
(IC = 10 mAdc, VCE	= 10 Vdc, f = 1.	.0 kHz)		hoe man	10170 H	1.2 8780	mmhos
SWITCHING CHARACT							1
Delay Time	(V _{CC} = 10 V	/dc, I _C = 30	00 mAdc, before selevisides	seems Diest _d AT)	KALLENG I	20	ns
Rise Time Kell	IB1 = 30 mA			olisi trios un	0 0	70	ns
Storage Time	(V _{CC} = 10 V	/dc, I _C = 30	00 mAdc,	ts	_	140	ns
Fall Time	I _{B1} = 30 mA				own <u>Vo</u> ltage	70	ns
Turn-On Time	(I _C = 300 m	Adc, I _{R1} =	30 mAdc) (0 = 9)	inot terrade.	agst <u>lo</u> V gai	75	ns
	. 0						
Turn-Off Time) Pulse Test: Pulse Wid			30 mAdc, I _{B2} = 30 mAdc) 2.0%.	at phase toff		nwob knests for Current	ns sand-some
) Pulse Test: Pulse Wid		ty Cycle ≤ 2	30 mAdc, I _{B2} = 30 mAdc) 2.0%.	ib = aav abv	Voltage (Ig (Vgg = 8.0 (Vgg = 8.0	Breakdown off Current	aga-roch porosili
) Pulse Test: Pulse Wid		ty Cycle ≤ 2	30 mAdc, I _{B2} = 30 mAdc) 2.0%.	ib = aav abv	Vde. Veg. Veg. Veg. Veg. Veg. Veg. Veg. Ve	Breakdown off Current	Meno-Sas
) Pulse Test: Pulse Wid		ty Cycle ≤ 2	30 mAdc, I _{B2} = 30 mAdc) 2.0%.	ib = aav abv	Voltage ((g (Vgg = 8.0 (Vgg = 8.0 () Vdc, Vgg 1)	Hreakdown toff Current (VCE = 6 OTERNATION TO Sain (ID =	ing-Egg Medic Co are threen
) Pulse Test: Pulse Wid	0ξ 0ξ	ty Cycle ≤ 2	30 mAdc, I _{B2} = 30 mAdc) (0.0%.	- 100 wAdo, Ite - 100 wAdo, Ite - 100 wAdo, Ite - 100 wAdo, Ite - 100 wAdo, Ite - 100 wAdo, Ite - 100 wAdo, Ite - 100 wAdo, Ite	Voltage (IE (VCE = 8.0 (VCE = 5.0 () Vdc. V8E () mAde, VC 50 mAde, VC	Hreakdown Toff Current Toff	Menor Canada
) Pulse Test: Pulse Wid	0ξ 0ξ	ty Cycle ≤ 2 RBCA gl	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (27dē =	The state The	Voltage (IE (VCE = 8.0 (VCE = 5.0 () Vdc. V8E () mAde, VC 50 mAde, VC	Hreakdown Toff Current Toff	Menor Canada
) Pulse Test: Pulse Wid	ith ≤ 300 μs, Dut	ty Cycle ≤ 2 330) gl grid tresk30√	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (2768 = 1654.m 0.1 1354.m 0.3 = (2768 = AT 354.m 0.1)	Total Tota	(Votage No. 70 mAde, Votage teff Current (Vog = 8. Sain flo = Sain flo = Sin flo = itter Saturat	Mentor-Brasiliano Tentro on AL CHARA Consent	
) Pulse Test: Pulse Wid	ith ≤ 300 μs, Dut	ty Cycle ≤ 2 RBCA gl	30 mAdc, I _{B2} = 30 mAdc) (2.0%. (2.0	The state The	(Votage No. 70 mAde, Votage Hreakdown Toff Current Toff	Mentor-Brasiliano Tentro on AL CHARA Consent	
Pulse Test: Pulse Wide Did Aug. Property Puls	300 μs, Dut 05 05	ty Cycle ≤ 2 330) gl grid tresk30√	30 mAdc, I _{B2} = 30 mAdc) (2.0%. (2.0	The state The	Voltage RE [VCE = 8.0 [VCE = 8.0 [VCE = 8.0 1) 1) 10 10 10 10 10 10 10 1	teff Current (Vog = 8. Sain flo = Sain flo = Sin flo = itter Saturat	ed recursion of the control of the c
90An 01 007 007 007 007 007 007 007	300 μs, Dut 05 05	ty Cycle ≤ 2 330) gl grid tresk30√	30 mAdc, I _{B2} = 30 mAdc) (2.0%. (2.0	Top Top	Voltage RE [VCE = 8.0 [VCE = 8.0 [VCE = 8.0 1) 10 10 10 10 10 10 10 10 1	toff Current (Vog = 8 Offensetted (Tog = 9 Online (Tog = 9) Online Saturation Seturation NAL Chaffa	and many or all and an analysis of the control of t
) Pulse Test: Pulse Wid	0ξ 0ξ 0ξ 8.0	ty Cycle ≤ 2 23.3 g1 g1 g1 freel3.3 v	30 mAdc, I _{B2} = 30 mAdc) = 2.0%. (2788 = 4 mAdc) = 3 mA	### 10 made, by the first of th	Voltage IIE [VCE = 8.0 [VCE = 8.0 [VCE = 8.0 11 12 13 14 15 16 17 16 17 17 17 18 18 18 18 18 18 18	toff Current (Vog = 8 Offensetted Offens	and many or and an analysis of the control of the c
) Pulse Test: Pulse Wide State And S	0ξ 0ξ 0ξ 8.0	ty Cycle ≤ 2 RED gl grid (res/30) (res/30)	30 mAdc, I _{B2} = 30 mAdc) = 3.0%. (27de = 4.00%) = 3.00% (27de = 4.0	Top Top	Voltage RE [VCE = 8.0 [VCE = 8.0 [VCE = 8.0 1) 1) 10 10 10 10 10 10 10 1	trankdown toff Current (Vog = 8 Offenstrest Creation Seturation Nat Chaffe Bandwid Hat Chaffe Betance (Vo	and many or and an analysis of the control of the c
90An 01 007 007 007 007 007 007 007	0ξ 0ξ 0ξ 8.0	ty Cycle < 2 RED gl grid (res/33) (res/38) (res/38)	30 mAdc, I _{B2} = 30 mAdc) = 3.0%. (27de = 4.00%) = 3.00% (27de = 4.0	## toff = 7 toff 10 toff	Voltage Rig (Vice = 8.0 (Vice = 8.0 (Vice = 8.0 1) Vide. Vgg 10 mAde. Vide. Vide. Vcltage Voltage CTERISTICS 10 Product 2 = - 5.0 Vide. 1 2 - 5.0 Vide. 1	trankdown toff Current (Vog = 8 Offenstrest Creation Seturation Nat Chaffe Bandwid Hat Chaffe Betance (Vo	ARACH POR PROPERTY OF THE PROP
90An 01 007 007 007 007 007 007 007	0ξ 0ξ 0ξ 8.0	ty Cycle < 2 RED gl grid (res/33) (res/38) (res/38)	30 mAdc, I _{B2} = 30 mAdc) = 3.0%. (27de = 4.00%) = 3.00% (27de = 4.0	F = 10 value 10 valu	Voltage (Ig. Volta	trankdown toff Current (Vog = 6 Otherstress Otherstress inter Saturation Saturation - Saturation MAL Chaffe Earthance (Vog Inter Cyge Inter Canance (Vog Inter Cyge Inter Cyg	ARACH POR PROPERTY OF THE PROP
Pulse Test: Pulse Wide	0ξ 0ξ 0ξ 8.0	ty Cycle < 2 RED gl grid (tex/33) (tex/38) (tex/38) gl gl gl gl gl gl gl gl	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (2768 = (2768 = A1, 354m 0.1 = (3768 = A1, 354m 0.0 = (354m 0.1 = (354	F = 10 value 10 valu	Voltage RE (Vice - 8.0 (Vice -	trankdown toff Current (Vog = 6 Otherstress Otherstress inter Saturation Saturation - Saturation MAL Chaffe Earthance (Vog Inter Cyge Inter Canance (Vog Inter Cyge Inter Cyg	and received to the control of the c
Pulse Test: Pulse Widom Pulse Test: Pulse Test: Pulse Widom Pulse Test: Pulse Test: Pulse Test: Pulse Test: Pulse Widom Pulse Test: Pulse Te	0ξ 0ξ 0ξ 8.0	ty Cycle < 2 RED gl grad (tex/33) (tex/38) yl gdo gdi	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (2768 = (2768 = A1, 354m 0.1 = (3768 = A1, 354m 0.0 = (354m 0.1 = (354	F + 10 whate, 15 = 100 whate, 15 = 10 whate, 16 = 1	Voltage (ig. 100 Voltage (ig. 100 Vdc. Vgg = 8.0 Vdc. Vgg	trankdown toff Current (Vog = 6 Otherstress Otherstress inter Saturation Saturation - Saturation MAL Chaffe Earthance (Vog Inter Cyge Inter Canance (Vog Inter Cyge Inter Cyg	and received to the control of the c
Pulse Test: Pulse Wide	0ξ 0ξ 0ξ 8.0	ty Cycle ≤ 2 23.3 g1 gnd (texi33.3 (texi38.9 ti odo2 odi2	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (2)**ee = (2)**e8 = (1)**bAm 0.1 = (1)**bAm 0.3 = (1)**bAm 0.1 = (1)**bAm 0.1 = (1)**bAm 0.3 = (1)**bAm 0.	F + 10 whate, 15 = 100 whate, 15 = 10 whate, 16 = 1	Voltage (ig. 100 Voltage (ig. 100 Vdc. Vgg = 8.0 Vdc. Vgg	trankdown toff Current (Vog = 6 Otherstress Otherstress inter Saturation Saturation - Saturation MAL Chaffe Earthance (Vog Inter Cyge Inter Cannon Inter Saturation Inter Saturatio	and received to the control of the c
Pulse Test: Pulse Wide	0ξ 0ξ 0ξ 8.0	ty Cycle ≤ 2 23.3 g1 gnd (texi33.3 (texi38.9 ti odo2 odi2 g1 g1	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (2)**ee = (2)**e8 = (1)**bAm 0.1 = (1)**bAm 0.3 = (1)**bAm 0.1 = (1)**bAm 0.1 = (1)**bAm 0.3 = (1)**bAm 0.	F + 10 whate, 15 = 100 whate, 15 = 10 whate, 16 = 1	Voltage (ig. 100 Voltage (ig. 100 Vdc. Vgg = 8.0 Vdc. Vgg	trankdown toff Current (Vog = 6 Otherstress Otherstress inter Saturation Saturation - Saturation MAL Chaffe Earthance (Vog Inter Cyge Inter Cannon Inter Saturation Inter Saturatio	and received to the control of the c
) Pulse Test: Pulse Wide	0ξ 0ξ 0ξ 8.0	ty Cycle < 2 233 g1 g1 g1 free1333 free138V free138V free138V g1 g1 g1 g1 g1 g1	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (3768 = (5768 = 47 dbAm 0.1 = 105Am 0.2 = 105Am 0.3 = 105Am 0.1 = 105Am 0.3 = 105Am 0.1 = 105Am 0.3 = 105Am	F + 10 whate, 15 = 100 whate, 15 = 10 whate, 16 = 1	Voltage (IE (VCE = 8.0 (VCE = 8.0 (VCE = 8.0 (ID mAde, VGE ID mAde, VCE ID mAde, VCE Voltage (VCE = 8.0 (VCC = 8.0 (toff Current (VCE = 8 CTEMETICS(ILLE Saunt ILLE Saunt ESTURBION PLAI CHARA CHARA CTE CHARA CTE COVAC, IC = 100	Alexandra (Alexandra (
Pulse Test: Pulse Wide	0ξ 0ξ 0ξ 8.0	ty Cycle < 2 233 g1 g1 g1 free1333 free138V free138V free138V g1 g1 g1 g1 g1 g1	30 mAdc, I _{B2} = 30 mAdc) 2.0%. (3°68 = (5°68 = 41 .55 m 0.1 = (5°68 = AT .	The state of the	Voltage (Ig. 100 Molecular St.	toff Current (VCE = 8 GENTERIOSE GENTER	edicine Base Alacabeta Alacabeta Base

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	12	Vdc
Collector-Base Voltage	VCBO	12	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC	80	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	edia PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	M °C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	200	°C/W

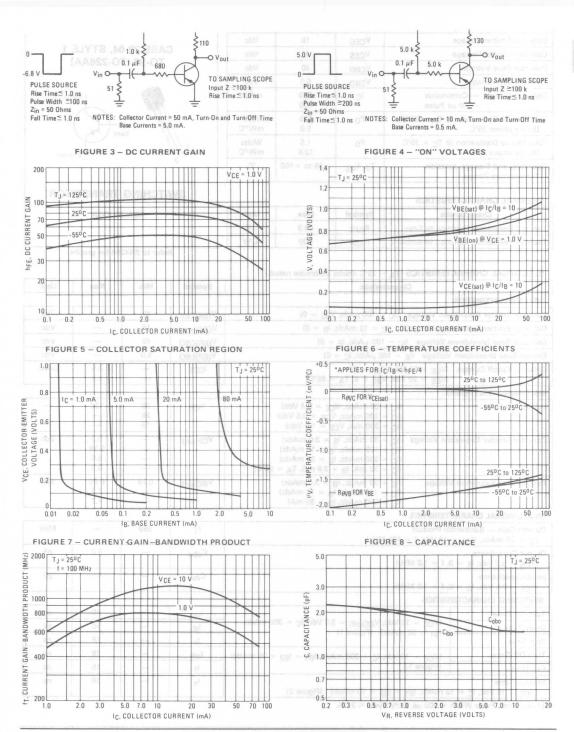
CASE 29-04, STYLE 1 TO-92 (TO-226AA)



SWITCHING TRANSISTOR

PNP SILICON TWO temple Hem?

70	Characteristic	Symbol		Max	Unit
OFF CHARACTERISTICS				1	
	vn Voltage ($I_C = 100 \mu\text{Adc}, V_{BE} = 0$)	V(BR)CES	12	1	Vdc
		VCEO(sus)	12	- Hr	Vdc
Collector-Emitter Sustaining Voltage(1) ($I_C = 10 \text{ mAdc}, I_B = 0$) Collector-Base Breakdown Voltage ($I_C = 100 \mu \text{Adc}, I_E = 0$)		V(BR)CBO	12	80	Vdc
	Voltage (IE = 100 μ Adc, IC = 0)	V(BR)EBO	4.0	dibiW — u.g.	Vdc
Collector Cutoff Current	(V _{CE} = 6.0 Vdc, V _{BE} = 0) (V _{CE} = 6.0 Vdc, V _{BE} = 0, T _A = 65°C)	CES		0.01	μAdc
Base Current (V _{CE} = 6.0	Vdc, V _{BE} = 0)	IB	_	10	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain $(I_C = 1)$ $(I_C = 5)$	0 mAdc, V _{CE} = 0.3 Vdc) 0 mAdc, V _{CE} = 1.0 Vdc)	hFE	30 20	120	_
Collector-Emitter Saturation	on Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$) ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$, $T_A = 65^{\circ}\text{C}$)	VCE(sat)	=	0.2 0.6 0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)		VBE(sat)	0.75 0.8 —	0.95 1.0 1.5	Vdc
SMALL-SIGNAL CHARAC	TERISTICS				
Current-Gain — Bandwidt	h Product (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	fT	500	_	MHz
Output Capacitance (VCE	3 = = 5.0 Vdc, IE = 0, f = 1.0 MHz)	Cobo	_	3.5	pF
Input Capacitance (VBE	= 0.5 Vdc, I _C = 0, f = 1.0 MHz)	Cibo	_	3.5	pF
SWITCHING CHARACTER	ISTICS				
Delay Time	$(V_{CC} = 6.0 \text{ Vdc}, I_{C} = 50 \text{ mAdc}, V_{BE(off)} = 1.9 \text{ Vdc},$	t _d	_	10	ns
Rise Time	$I_{B1} = 5.0 \text{ mAdc}$	tr	_	30	ns
Storage Time	$(V_{CC} = 6.0 \text{ Vdc}, I_C = 50 \text{ mAdc}, I_{B1} = I_{B2} = 5.0 \text{ mAdc})$	t _S	_	20	ns
Fall Time		tf		12	ns
Turn-On Time (V _{CC} = 6.0 Vdc, I _C = 50 mAdc, V _{BE(off)} = 1.9 Vdc, I _{B1} = 5.0 mAdc) (V _{CC} = 1.5 Vdc, I _C = 10 mAdc, I _{B1} = 0.5 mAdc)		ton	=	25 60	ns
Turn-Off Time (V _{CC} = 6.0 Vdc, I _C = 5	0 mAdc, V _{BE(off)} = 1.9 V, I _{B1} = I _{B2} = 5.0 mAdc) 0 mAdc, I _{B1} = I _{B2} = 0.5 mAdc)	^t off	-	35 75	ns



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

WAXIWOW NATINGS			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Emitter Voltage	VCES	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous — 10 µs Pulse	Ic and	300 500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12.0	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS3646

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



SWITCHING TRANSISTOR

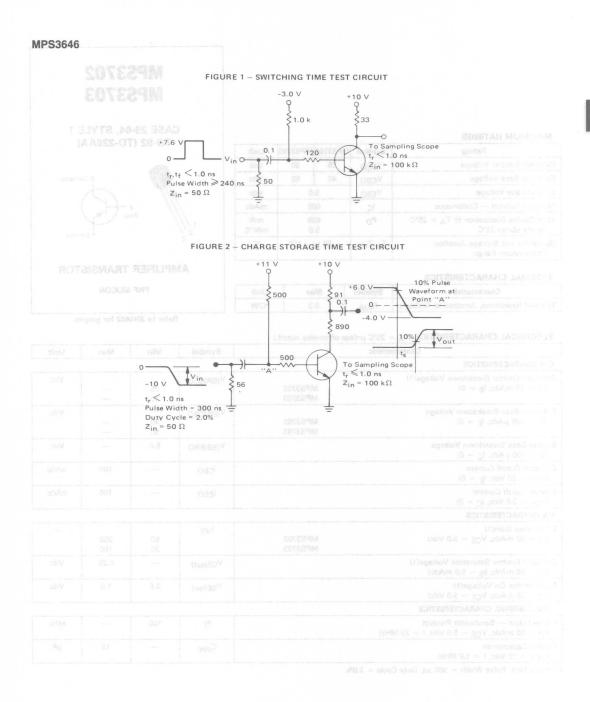
NPN SILICON

Refer to 2N4264 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown V	oltage (I _C = 100 μAdc, V _{BE} = 0)	V(BR)CES	40		Vdc
Collector-Emitter Sustaining Vo	oltage(1) (I _C = 10 mAdc, I _B = 0)	VCEO(sus)	15	-	Vdc
Collector-Base Breakdown Volt	age $(I_C = 100 \mu Adc, I_E = 0)$	V(BR)CBO	40	-	Vdc
Emitter-Base Breakdown Volta	ge ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	13.103 - 5	Vdc
Collector Cutoff Current (V _{CE} = 20 Vdc, V _{BE} = 0) (V _{CE} = 20 Vdc, V _{BE} = 0, T _A = 65°C)		ICES		0.5 3.0	μAdc
ON CHARACTERISTICS(1)					18.0
DC Current Gain	$(I_C = 30 \text{ mAdc}, V_{CE} = 0.4 \text{ Vdc})$ $(I_C = 100 \text{ mAdc}, V_{CE} = 0.5 \text{ Vdc})$ $(I_C = 300 \text{ mA}, V_{CE} = 1.0 \text{ Vdc})$	hFE	30 25 15	120 — —	an
Collector-Emitter Saturation Vo	Itage (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 30 mA, I _B = 3.0 mA, T _A = 65°C)	VCE(sat)	Ī	0.2 0.28 0.5 0.3	Vdc
Base-Emitter Saturation Voltag	e (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc) (I _C = 300 mAdc, I _B = 30 mA)	V _{BE(sat)}	0.73	0.95 1.2 1.7	Vdc
SMALL-SIGNAL CHARACTERIS	STICS OF THE STATE	02 01 60	9.0	si 20.0	0.0
Current-Gain — Bandwidth Pro (I _C = 30 mAdc, V _{CE} = 10 V		fτ	350	ruianauo -	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f =	1.0 MHz)	C _{obo}		5.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f =	1.0 MHz)	C _{ibo}	use I		pF
SWITCHING CHARACTERISTIC	s				peg
Turn-On Time		ton		18	ns
	(V _{CC} = 10 Vdc, V _{BE(off)} = 3.0 Vdc, I _C = 300 mAdc, I _{B1} = 30 mAdc) (Figure 1)			10	ns
Rise Time				15	ns
Turn-Off Time (Vo	$C = 10 \text{ Vdc}, I_C = 300 \text{ mAdc}, I_{B1} = I_{B2} = 30 \text{ mAdc}$	toff		28	ns
	ure 1)	tf		15	ns
Storage Time		te		18	ns

 $(V_{CC} = 10 \text{ Vdc}, I_C = 10 \text{ mAdc}, I_{B1} = I_{B2} = 10 \text{ mAdc})$ (Figure 2)



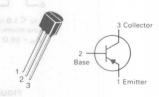
Rating	Symbol	MPS3702	MPS3703	Unit
Collector-Emitter Voltage	VCEO	25	30	Vdc
Collector-Base Voltage	VCBO	40	50	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	6	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		25	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	o + 150	10 A°C

THERMAL CHARACTERISTICS

THE MINE OF A THOU TOO			
Characteristic TOTAL TOTAL	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	R ₀ JA	0.2	°C/W

MPS3702 MPS3703

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N4402 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		-1	.,0		
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)		V(BR)CEO	25 30		Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	MPS3702 MPS3703	V(BR)CBO	40 50		Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)		V(BR)EBO	5.0	_	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)		ICBO	-	100	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)		IEBO		100	nAdc
ON CHARACTERISTICS					
DC Current Gain(1) (I _C = 50 mAdc, V _{CE} = 5.0 Vdc)	MPS3702 MPS3703	hFE	60 30	300 150	_
Collector-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{CE(sat)}	_	0.25	Vdc
Base-Emitter On Voltage(1) (I _C = 50 mAdc, V _{CE} = 5.0 Vdc)		VBE(on)	0.6	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 5.0 Vdc, f = 20 MHz)		fT	100	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, f = 1.0 MHz)		C _{obo}	_	12	pF

FIGURE 1 - SWITCHING TIME TEST CIRCUIT

⁽¹⁾ Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

MP53866

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	V _{CBO}	50	Vdc
Emitter-Base Voltage	VEBO	5 0	Vdc
Collector Current — Continuous	IC	600	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0 (ar +	mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.2	°C/W

MPS3704 MPS3705

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N4400 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) of to seeing 0°ES = 471 2017 218313 ARAMO JACKS TO 13

shou xaffi niff Ch	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CT SHIS TICE	MARI LIPO
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _E = 0)	(1) sua 1830 V		V(BR)CEO		nitter <u>B</u> reakd mAdd, Rgg	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	VCEO(sus)		V(BR)CBO	(0)	nitter <u>S</u> ustail mAdc Ig =	0 5 - [1]
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	O83(88)¥		V(BR)EBO	5.0 V	Bre <u>ak</u> dowr μΑdc, Ig =	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)	0301		ICBO	- 40	100	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)	XEO		(3°0 II = JEBO		100 To	nAdc
ON CHARACTERISTICS			7,497	IL BOA GIS	THA WILL	
DC Current Gain(1) (I _C = 50 mAdc, V _{CE} = 2.0 Vdc)	083	MPS3704 MPS3705	hFE	100 50	300 150	D - BAN DACHARA
Collector-Emitter Saturation Voltage((I _C = 100 mAdc, I _B = 5.0 mAdc)	1) 390	MPS3704 MPS3705	VCE(sat)	= 5. <u>0 V</u> dc)(1 + 0.0 <u>Vd</u> c)	0.6	Vdc
Base-Emitter On Voltage(1) (I _C = 100 mAdc, V _{CE} = 2.0 Vdc)	VCE(sat)		VBE(on)	0.5 non tobAm 03	1.0 - gl	Vdc
SMALL-SIGNAL CHARACTERISTICS				SOFT BINETO	NAL CHARA	DIE-THUE S
Current-Gain — Bandwidth Product $(I_C = 50 \text{ mAdc}, V_{CE} = 2.0 \text{ V}, f = 2.0 \text{ V})$	0 MHz)		200 MHzd	100	: — <u>Sa</u> ndwii nAdc, Vog	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MH	Cobo		Cobo	0, r = 1,0 MIH	12	pF
) Pulse Test: Pulse Width = 300 μs,	Duty Cycle = 2.0%.				1837 J	MOUTHER

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

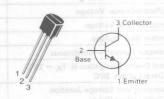
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	VCBO	55	Vdc
Emitter-Base Voltage	VEBO	3.5	Vdc
Collector Current — Continuous	Ic	0.4	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	.6 °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _U C	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS3866

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

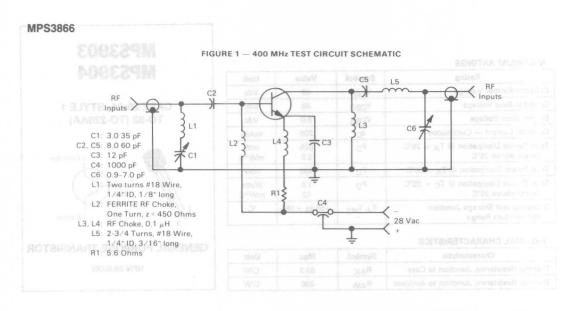


AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and passing the second of the second

dinU man Charac	teristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				ACTES/819CS	OFF CHARL
Collector-Emitter Breakdown Voltage (I _C = 5.0 mAdc, R _{BE} = 10 Ω)	VERNO	VCER(sus)	55	nite -B reslot mAdo, lgre	Vdc
Collector-Emitter Sustaining Voltage (I _C = 5.0 mAdc, I _B = 0)	Year	VCEO(sus)		ese li m bledor I y Add, lg m	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	BlastA	V _{(BR)EBO}	3.5	iwoti la ns - - gl _u anAu	
Collector Cutoff Current (V _{CE} = 28 Vdc, I _B = 0)	1680	ICEO	- (0	0.02	mAdc
Collector Cutoff Current $(V_{CE} = 30 \text{ Vdc}, V_{BE} = -1.5 \text{ Vdc (Rev.)} $ $(V_{CE} = 55 \text{ Vdc}, V_{BE} = -1.5 \text{ Vdc (Rev.)} $. T _C = 150°C)	ICEX	_ (0	5.0 0.1	
Emitter Cutoff Current (VBE = 3.5 Vdc, I _C = 0)		IEBO	Interfere	0.1	mAdc
ON CHARACTERISTICS	Wessyns			30	
DC Current Gain (I _C = 360 mAdc, V _{CE} = 5.0 Vdc)(1) (I _C = 50 mAdc, V _{CE} = 5.0 Vdc)	WESSTON VCESS	hFE (200	
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 20 mAdc)	olaev	V _{CE(sat)}		pest 1.0 m	Vdc
SMALL-SIGNAL CHARACTERISTICS			степленоз	NAL CHARA	SIR-LIAM
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 15 Vdc, f = 200	MHz)	f _T	500		MHz
Output Capacitance (V _{CB} = 28 Vdc, I _E = 0, f = 1.0 MHz)	Cone	Cobo	- 1.0 MH	3.0	pFu
FUNCTIONAL TEST		puty Cycle = 2.0%.	h = 300 µs, l	Pulsa Wate	Pulse Test
Amplifier Power Gain $(V_{CC} = 28 \text{ Vdc}, P_{out} = 1.0 \text{ W}, f = 400 \text{ M})$	MHz)	Gpe	10		dB
Collector Efficiency (V _{CC} = 28 Vdc, P _{out} = 1.0 W, f = 400	MHz)	η	45	-	%



		C Teater-Emitter Breakdown Voltage(1) Up = 1.0 mAdd, fg = 0)

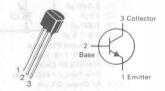
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Power Dissipation @ T _A = 60°C	PD	450	mW
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS3903 MPS3904

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)		V(BR)CEO	40	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc$, $I_E = 0$)		V _(BR) CBO	60	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V _{(BR)EBO}	6.0	_	Vdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{EB(off)} = 3.0 Vdc)		CEX	-	50	nAdc
Base Cutoff Current (VCE = 30 Vdc, VEB(off) = 3.0 Vdc)		IBL	-	50	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	MPS3903 MPS3904	hFE	20 40	=	-
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MPS3903 MPS3904		35 70		
(I _C = 10 mAdc, V_{CE} = 1.0 Vdc)	MPS3903 MPS3904		50 100	150 300	
(I _C = 50 mAdc, V_{cE} = 1.0 Vdc)	MPS3903 MPS3904		30 60	=	
$I_C = 100 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	MPS3903 MPS3904		15 30	_	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)		VCE(sat)		0.2	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{BE} (sat)	0.65	0.85 1.0	Vdc

	Characteristic		Symbol	Min	Max	Unit
SMALL-SIGNAL CHA	RACTERISTICS					
Current-Gain — Band (I _C = 10 mAdc, V _C	width Product E = 20 Vdc, f = 100 MHz)	MPS3903 MPS3904	¥o.f⊤.iov :	150 200	ALLEXA	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E	= 0, f = 100 kHz)	NS = 0	C _{obo}	- 1	4.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC	= 0, f = 100 kHz)	01 2	C _{ibo}		8.0	pF
Input Impedance (I _C = 1.0 mAdc, V ₀	CE = 10 Vdc, f = 1.0 kHz)	MPS3903 MPS3904	h _{ie}	0.5 1.0	8.0 10	kΩ
Voltage Feedback Ra (I _C = 1.0 mAdc, V _C	tio CE = 10 Vdc, f = 1.0 kHz)	MPS3903 MPS3904	h _{re}	0.1 0.5	5.0 8.0	X 10-4
Small-Signal Current (I _C = 1.0 mAdc, V ₀	Gain CE = 10 Vdc, f = 1.0 kHz)	MPS3903 MPS3904	h _{fe}	50 100	200 400	- 10 -
Output Admittance (I _C = 1.0 mAdc, V ₀		NOISE FIGURE CONTO	h _{oe}	1.0	40	μmhos
Noise Figure ($I_C = 100 \mu Adc, V_0$ f = 10 Hz to 15.7 k	$CE = 5.0 \text{ Vdc}, RS = 1.0 \text{ k}\Omega,$	MPS3903 MPS3904	H 601 GMAG	HORRAH -	6.0 5.0	dB
SWITCHING CHARA	CTERISTICS	500 V (500 V	about I factor			x 51
Delay Time	$(V_{CC} = 3.0 \text{ Vdc}, V_{BE(off)} = 0.9$		td		35	ns
Rise Time	I _C = 10 mAdc, I _{B1} = 1.0 mAd	c)	tr		50	ns
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mAdd	MPS3903 MPS3904	ts		800 900	ns

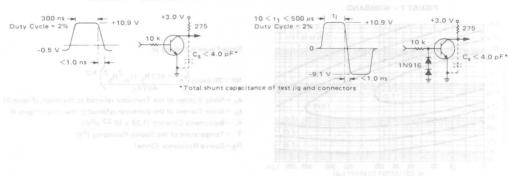
Delay Time	$(V_{CC} = 3.0 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc}$	o,	td		35	ns	
Rise Time	I _C = 10 mAdc, I _{B1} = 1.0 mAdc)		tr		50	ns	
Storage Time		MPS3903	ts		800	ns	
	$(V_{CC} = 3.0 \text{ Vdc}, I_{C} = 10 \text{ mAdc},$	MPS3904		900	900		
Fall Time	$I_{B1} = I_{B2} = 1.0 \text{ mAdc}$		tf	16/411	90	ns	

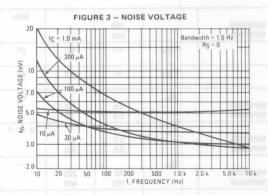
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

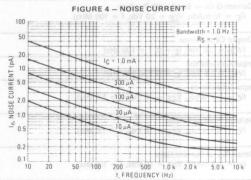
EQUIVALENT SWITCHING TIME TEST CIRCUITS

FIGURE 1 - TURN-ON TIME

FIGURE 2 - TURN-OFF TIME

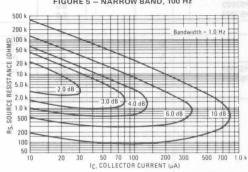






NOISE FIGURE CONTOURS (VCE = 5.0 Vdc, TA = 25°C)

FIGURE 5 - NARROW BAND, 100 Hz





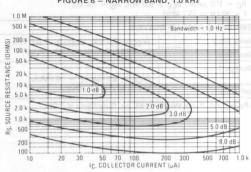
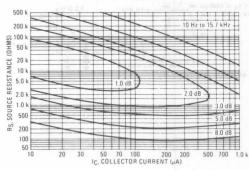


FIGURE 7 - WIDEBAND



Noise Figure is Defined as:

NF =
$$20 \log_{10} \left(\frac{e_n^2 + 4KTR_S + I_n^2 R_S^2}{4KTR_S} \right) 1/2$$

en = Noise Voltage of the Transistor referred to the input. (Figure 3)

In = Noise Current of the transistor referred to the input (Figure 4)

 $K = Boltzman's Constant (1.38 \times 10^{-23} j/^{O}K)$

T = Temperature of the Source Resistance (OK)

Rs = Source Resistance (Ohms)

TYPICAL STATIC CHARACTERISTICS

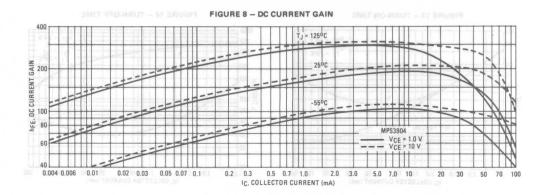


FIGURE 9 - COLLECTOR SATURATION REGION

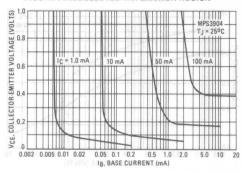


FIGURE 10 - COLLECTOR CHARACTERISTICS

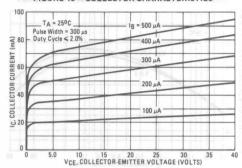


FIGURE 11 - "ON" VOLTAGES

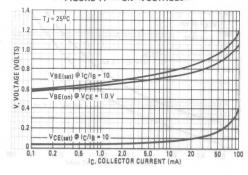
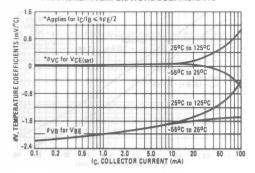
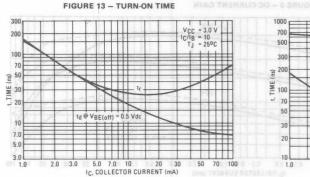
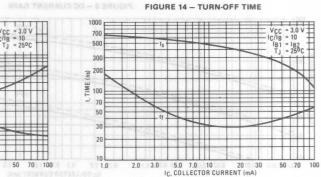
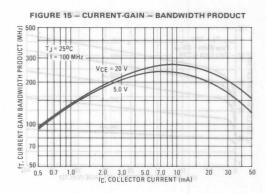


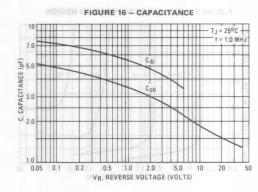
FIGURE 12 - TEMPERATURE COEFFICIENTS

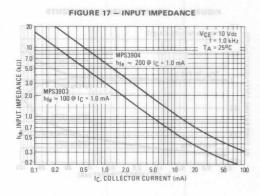


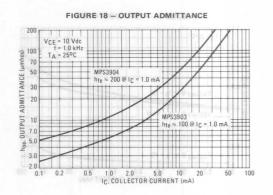


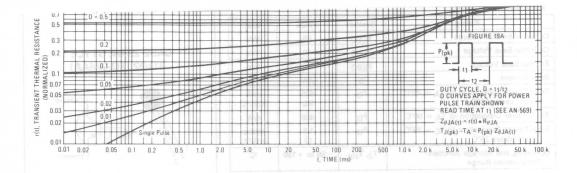


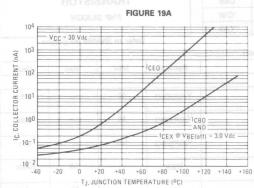


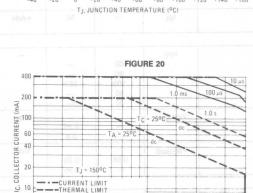












4.0 6.0 8.0 10 20 VCE, COLLECTOR-EMITTER VOLTAGE (VOLTS)

SECOND BREAKDOWN LIMIT

4.0

DESIGN NOTE: USE OF THERMAL RESPONSE DATA

A train of periodical power pulses can be represented by the model as shown in Figure 19A. Using the model and the device thermal response the normalized effective transient thermal resistance of Figure 19 was calculated for various duty cycles.

To find $Z_{\theta,j,k}(t)$, multiply the value obtained from Figure 19 by the steady state value $R_{\theta,j,k}(t)$.

Example

The MPS3903 is dissipating 2.0 watts peak under the following conditions:

 t_1 = 1.0 ms, t_2 = 5.0 ms. (D = 0.2) Shake 0.1 Using Figure 19 at a pulse width of 1.0 ms and D = 0.2, the reading of r(t) is 0.22.

The peak rise in junction temperature is therefore $\Delta T = r(t) \times P_{(pk)} \times R_{\theta} J_A = 0.22 \times 2.0 \times 200 = 88^{\circ}C.$

For more information, see AN-569.

The safe operating area curves indicate IC-VCE limits of the transistor that must be observed for reliable operation. Collector load lines for specific circuits must fall below the limits indicated by the applicable curve.

The data of Figure 20 is based upon $T_{J(pk)}=150^{\circ}C;$ T_{C} or T_{A} is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided $T_{J(pk)} \leqslant 150^{\circ}C$. $T_{J(pk)}$ may be calculated from the data in Figure 19. At high case or ambient temperatures, thermal limitations will reduce the power than can be handled to values less than the limitations imposed by second breakdown.

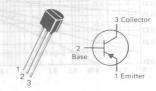
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Base Current	IB	200	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Power Dissipation @ T _A = 60°C	PD	450	mW
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS3906

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, I _B = 0)		V(BR)CEO	40		Vdc
Collector-Base Breakdown Voltage (IC = 10 μAdc, IE = 0) w 0.5 generalization S00529M and		V(BR)CBO	40		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0) = 0.2 am 0.3 = c1 am 0.7 = r1	27.4 (12.1 (1	V(BR)EBO	5.0		Vdc
Collector Cutoff Current (VCE = 30 Vdc, VBE(off) = 3.0 Vdc)	191× 101+ 02	ICEX	10 - 02 - 0	50	nAdc
Base Cutoff Current (VCE = 30 Vdc, VBE(off) = 3.0 Vdc)		IBL	_	50	nAdc
ON CHARACTERISTICS(1)		BOLL ST			
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc)		h _{FE}	60 80	_	
(I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 50 mAdc, V _{CE} = 1.0 Vdc) (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)		(10.1)	100 60 30	300	2365
Collector-Emitter Saturation Voltage Common Set (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)		VCE(sat)		0.25 0.4	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)		VBE(sat)	0.65	0.85 0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS			18	ALI THE RELIGIO	- 101 /2
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 V, f = 100 MHz)		fT	250	HRU URAD	MHz

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

				5	Symbol	Min	Max	Unit	
					C _{obo} — 4.5		4.5	pF	
1563.5	101100	na co	espend a		Cibo	_		pF %	
Velc	26		30	10V	hie	2.0	egallos ratio	k ohms	
obV	UK	6.8	0.0	ASA ASA	h _{re}	1.0	10 spatioV	X 10-4	
obArn Wm		800		jol Pin	hfe	100	400	fot a <u>ct</u> er Cu fot il Puwar	
OnWine.		5.0		109	h _{oe}	3.0		μ mhos	
o. f = 10 H	z to 15	7 kHz) =		NF	notion	-	dB	
	aby aby aby abArn Wrn Drywns W	oby 85 oby 08 oby 08 Wm Drwn W	25 Vdc 26 20 20 20 20 20 20 20 20 20 20 20 20 20	90 90 Vdc 5,0 Vdc 200 mAdc 025 mW 6,0 cnWC 1,5 W	VCI 30 25 Vdc VCC 90 30 Vdc VCC 90 30 Vdc VCC 90 30 Vdc CC 800 mAdc CC 800 mAV CR 6.0 mW/C	Cibo hie	Cobo — Cibo — Step 1	Cobo — 4.5 Cibo — 10 — 10 — 10 — 12 — 12 — 12 — 12 — 12	

Delay Time	(V _{CC} = 3.0 Vdc, V _{BE(off)} = 0.5 Vdc		t _d	22(T2)/	35	ns
Rise Time	(I _C = 10 mAdc, I _{B1} = 1.0 mAdc)	Milax	iceliany@ tr	- 5120	50	ns
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mAdc, VAO	200	ALAM t _s in	eldmA-et noit	600	ns
Fall Time	$I_{B1} = I_{B2} = 1.0 \text{ mAdc}$		tf	_	90	ns

(1) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

Outlook Expeditance VCB - 5.0 V, Ig = 0, f = 100 lots)			

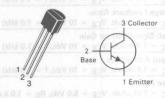
Rating	Symbol	MPS4123	MPS4124	Unit
Collector-Emitter Voltage	VCE	30	25	Vdc
Collector-Base Voltage	VCB	40	30	Vdc
Emitter-Base Voltage	VEB	5	.0	Vdc
Collector Current — Continuous	Ic	2	00	mAdc
Total Power Dissipation @ T _A = 25°C Derate above 25°C	PD		625 5.0	
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		W mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic —	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS4123

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

FI FCTRICAL	CHARACTERISTICS	ITO -	25°C unlace	otherwise noted)	

Characterist	ic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 1.0 mA, I _B = 0)	MPS4123 MPS4124	V(BR)CEO	30 25	=	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu A, I_E = 0$)	MPS4123 MPS4124	V(BR)CBO	40 30	_	Vdc
Emitter-Base Breakdown Voltage (I _C = 0, I _E =	10 μΑ)	V(BR)EBO	5.0	To de-	Vdc
Collector Cutoff Current (V _{CB} = 20 V, I _E = 0)		Ісво	_	50	nAdo
Emitter Cutoff Current (VEB = 3.0 V, IC = 0)		IEBO	_	50	nAdo
ON CHARACTERISTICS					
DC Current Gain $(I_C = 2.0 \text{ mA, V}_{CE} = 1.0 \text{ V})$ $(I_C = 50 \text{ mA, V}_{CE} = 1.0 \text{ V})$	MPS4123 MPS4124 MPS4123 MPS4124	hFE	50 120 25 60	150 360 —	_
Collector-Emitter Saturation Voltage (I _C = 50 mA, I _B = 5.0 mA)		VCE(sat)		0.3	Vdc
Base-Emitter Saturation Voltage (I _C = 50 mA, I _B = 5.0 mA)		VBE(sat)	-	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mA, V _{CE} = 20 V, f = 100 MHz)	MPS4123 MPS4124	fT	100 170		MHz
Output Capacitance ($V_{CB} = 5.0 \text{ V}$, $I_{E} = 0$, $f = 100 \text{ kHz}$)		C _{ob}	-	4.0	pF
Input Capacitance ($V_{BE} = 0.5 \text{ V, } I_{C} = 0, f = 100 \text{ kHz}$)	MPS4123 MPS4124	C _{ib}	=	14 13.5	pF
Small-Signal Current Gain ($I_C = 2.0 \text{ mA}$, $V_{CE} = 1.0 \text{ V}$, $f = 1.0 \text{ kHz}$)	MPS4123 MPS4124	h _{fe}	50 120	200 480	_
Noise Figure (I _C = 100 μ A, V _{CE} = 5.0 V, R _S = 1.0 k Ω , Noise Bandwidth = 10 Hz to 15.7 kHz)	MPS4123 MPS4124	NF	=	6.0 5.0	dB

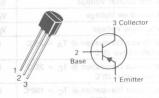
Rating	Symbol	MPS4125	MPS4126	Unit
Collector-Emitter Voltage	VCE	30	25	Vdc
Collector-Base Voltage	VCB	. 30	25	Vdc
Emitter-Base Voltage	VEB	4	.0	Vdc
Collector Current — Continuous	Ic -	21	00	mAdc
Total Power Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		W mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS4125 MPS4126

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR PNP SILICON

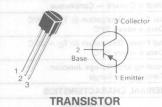
ELECTRICAL CHARACTERISTICS ($T_C = 25^{\circ}C$ unless otherwise noted.)

Character	ristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					ennemana	
Collector-Emitter Breakdown Voltage (I _C = 1.0 mA, I _B = 0)	MPS4125 MPS4126	610	V(BR)CEO	30 25	citter Breakor	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ A, I _E = 0)	MPS4125 MPS4126	280 260A	V(BR)CBO	30 25	— (Arr) — (Arr)	Vdc
Emitter-Base Breakdown Voltage (I _C = 0, I _E	= 10 μΑ)		V(BR)EBO	4.0	eleteu C rathin	Vdc
Collector Cutoff Current (V _{CB} = 20 V, I _E = 0	0)	688	СВО	_	50	nAdc
Emitter Cutoff Current (VEB = 3.0 V, IC = 0)		AUCSIE DV. KPS	IEBO	-	50	nAdc
ON CHARACTERISTICS	80.4	0.7%	MESM	aBayes a	(Au	01 = 11
DC Current Gain $(I_C = 2.0 \text{ mA, V}_{CE} = 1.0 \text{ V})$ $(I_C = 50 \text{ mA, V}_{CE} = 1.0 \text{ V})$	MPS4126 MPS4125		hFE	50 120 25 60	150 360	or <u>—</u> II establich inst or — II or — IIo
Collector-Emitter Saturation Voltage (I _C = 50 mA, I _B = 5.0 mA)		250 250 340 MPSAZSO	VCE(sat)	- (3)	0.4 _{TV} 0	Vdc
Base-Emitter Saturation Voltage (I _C = 50 mA, I _B = 5.0 mA)	21		V _{BE(sat)}	_	10 0.95 a ric	Vdc
SMALL-SIGNAL CHARACTERISTICS					SOSTERISTO	ATAR: M
Current-Gain — Bandwidth Product (I _C = 10 mA, V _{CE} = 20 V, f = 100 MHz)	MPS4125 MPS4126	est	f _T	150 170	Gain —	MHz
Output Capacitance (VCB = 5.0 V, IE = 0, f = 100 kHz)		250;A. 249	C _{ob}	_(V 0)	4.5 A	pF pF
Input Capacitance (V _{BE} = 0.5 V, I _C = 0, f = 100 kHz)	MPS4125 MPS4126	085 085	C _{ib}	-(V 0.	12 11.5	pF
Small-Signal Current Gain (I _C = 2.0 mA, V _{CE} = 1.0 V, f = 1.0 kHz)	MPS4125 MPS4126		h _{fe}	50 120	200 480	i di via - li ga
Noise Figure (I _C = 100 μ A, V _{CE} = 5.0 V, R _S = 1.0 k Ω , Noise Bandwidth = 10 Hz to 15.7 kHz)	MPS4125 MPS4126		NF	(f) <u>apatio</u> (Am	5.0 4.0	dB

INIAAIIVIOIVI RATIIVOS				
Rating	Symbol	MPS4250	MPS4249 MPS4250A	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Emitter Voltage	VCES	40	60	Vdc
Collector-Base Voltage	VCBO	40	60	Vdc
Emitter-Base Voltage	VEBO	5.0	5.0	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	1.5 12	mW mW/°C
Total Device Dissipation @ T _C = 100°C Derate above 100°C	PD	30	081+ 013	9- 8
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +125		°C
Junction Temperature	TJ	JinU 1	25 ×4.14	°C
Lead Temperature (10 seconds)	TL	W/3° 2	260	

MPS4249 MPS4250 MPS4250A

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



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PNP SILICON

ELECTRICAL CHARACTERISTICS (TA	= 25°C unless otherwise noted.)
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Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					NI GULLIA	10-14
Collector-Emitter Breakdown Voltage (I _C = 10 µA) (I _C = 5.0 mA) (I _C = 5.0 mA)	MPS4249 MPS4250 MPS4250A	MP54126 MP54126 MP54126 MP54126	V(BR)CES	60 40 60	= gt_A/n = gt_A/n bxhe <u>nt </u> = as 0 = <u>at_A</u>	DDV
Collector-Emitter Sustaining Voltage(1) (I _C = 5.0) (I _C = 5.0)	MPS4250 MPS4249, MPS4250A	(A	V(BR)CEO(sus)	40 60	e Brasiders	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ A) (I _C = 10 μ A)	MPS4250 MPS4249, MPS4250A		V(BR)CBO	40 60	CTE <u>RIB</u> TIO	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ A)		WPS4135	V(BR)EBO	5.0	BOV_Am	Vdc
Collector Cutoff Current (VCB = 40 V) (VCB = 50 V) (VCB = 40 V, TA = 65°C)	MPS4249, MPS4250A MPS4250 MPS4249, MPS4250	MPS4128	Ісво	ation Volta 0 m <u>A)</u>	10 10 3.0	nA Services Off = 50
Emitter Cutoff Current (VBE = 3.0 V)	VBE(sat)		IEBO	ag <u>stlo</u> v m (Am 0.	20	nA
ON CHARACTERISTICS				OF PERSONS	HAND JAY	JIS-LIEN
DC Current Gain (I _C = 100 μA, V _{CE} = 5.0 V) (I _C = 100 μA, V _{CE} = 5.0 V) (I _C = 1.0 mA, V _{CE} = 5.0 V) (I _C = 1.0 mA, V _{CE} = 5.0 V)	MPS4249 MPS4250,A MPS4249 MPS4250	MPSA128 MPSA128	hFE _{HIM} 00	100 250 100 250	300 700 —	- 304)
$(I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V})$ $(I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V})$	MPS4249 MPS4250		(2)	100 250	# 3F V 8.	18/A)
Collector-Emitter Saturation Voltage(1) (I _C = 10 mA, I _B = 0.5 mA)	atr	MPS4126 MPS4126	VCE(sat)	= ₹.₩0.1 ±	0.25	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 10 mA, I _B = 0.5 mA)	40	MPS4125	V _{BE} (sat)	88 V 0.8	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Output Capacitance (VCB = 5.0 V, f = 1.0 MHz)			C _{obo}	-	6.0	pF

MPS4249, MPS4250, MPS4250A

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic			S	Symbol	Min	Max	Unit
Input Capacitance (V _{BE} = 0.5 V, f = 1.0 MHz)				Cibo	_ 8	16	pF
	SnU	40867	Symbel			etsfl	
Small-Signal Current Gain (I _C = 1.0 mA, V _{CE} = 5.0 V, f = 1.0 kHz) (I _C = 1.0 mA, V _{CE} = 5.0 V, f = 1.0 kHz)		MPS4249 MPS4250,A	VCBD.	hfe	100 250	500 800	(201 8) (2018) (2019)
$(I_C = 0.5 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 20 \text{ MHz})$		MPS4249,50	DBBV		2.0	aga tto V ca	as isit mā
Noise Figure $ \begin{aligned} &\text{No ise Figure} \\ &\text{(I}_{C} = 20 \ \mu\text{A}, \text{V}_{CE} = 5.0 \ \text{V}, \text{R}_{S} = 10 \ \text{k}\Omega, \\ &\text{f} = 1.0 \ \text{kHz}, \text{P}_{BW} = 150 \ \text{Hz}) \\ &\text{(I}_{C} = 20 \ \mu\text{A}, \text{V}_{CE} = 5.0 \ \text{V}, \text{R}_{S} = 10 \ \text{k}\Omega, \\ &\text{f} = 1.0 \ \text{kHz}, \text{P}_{BW} = 150 \ \text{Hz}) \\ &\text{(I}_{C} = 250 \ \mu\text{A}, \text{V}_{CE} = 5.0 \ \text{V}, \text{R}_{S} = 1.0 \ \text{k}\Omega, \\ &\text{f} = 1.0 \ \text{kHz}, \text{P}_{BW} = 150 \ \text{Hz}) \\ &\text{(I}_{C} = 250 \ \mu\text{A}, \text{V}_{CE} = 5.0 \ \text{V}, \text{R}_{S} = 1.0 \ \text{k}\Omega, \end{aligned} $	blaAm	08	91	NF		O — premiu	dB
		MPS4250,A	ďq	26°C	= <u>дТ</u> <u>()</u> п	2.0	i el i tot e e I
		MPS4249	OR	0.88	- 3 <u>T</u> ⊕ n	3.0	
		MPS4250,A	gisT -LT		полопис	2.0	
$f = 1.0 \text{ kHz}, P_{BW} = 150 \text{ Hz})$		MPS4249	-			3.0	

(1)	Pulse Test	Pulse Width	- 300 46	Duty Cve	do - 2 0%	

SULTCHING TRANSISTOR		

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	12	Vdc
Collector-Base Voltage	VCBO	12	Vdc
Emitter-Base Voltage	VEBO	08.81 4.5 9M	Vdc
Collector Current — Continuous	Ic	80	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 12	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



SWITCHING TRANSISTOR

PNP SILICON

Refer to MPS3640 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

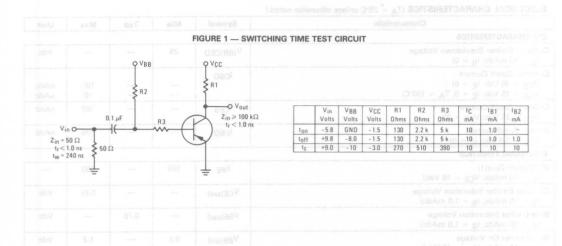
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (IC = 100 µAdc, VBE = 0)	V(BR)CES	12		Vdc
Collector-Emitter Sustaining Voltage(1) (IC = 3.0 mAdc, IB = 0)	VCEO(sus)	12	_	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	V(BR)CBO	12	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc$, $I_C = 0$)	V(BR)EBO	4.5	_	Vdc
Collector Cutoff Current $(V_{CE} = 6.0 \text{ Vdc}, V_{BE} = 0)$ $(V_{CE} = 6.0 \text{ Vdc}, V_{BE} = 0, T_{A} = +65^{\circ}\text{C})$	ICES	=	0.01 5.0	μAdc
ON CHARACTERISTICS(1)				
DC Current Gain (I _C = 1.0 mAdc, V_{CE} = 0.5 Vdc) (I _C = 10 mAdc, V_{CE} = 3.0 Vdc) (I _C = 50 mAdc, V_{CE} = 1.0 Vdc)	hFE	15 30 30	120	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)	VCE(sat)	Ξ	0.15 0.5	Vdc
Base-Emitter On Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)	VBE(sat)	0.75	0.95 1.5	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	700		MHz
Input Capacitance (VBE = 0.5 Vdc , IC = 0 , f = 1.0 MHz)	C _{ibo}		3.5	pF
Collector-Base Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_{E} = 0$, $f = 1.0 \text{ MHz}$)	C _{cb}	_	3.0	pF

ELECTRICAL CHARACTERISTICS	(continued) (TA	= 25°C unless	otherwise noted.)
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Symbol	Min	Max	Unit
Voer		apshoV s	pet cone.
ton	_	15 V	ns
0 t _d	2000	10 10	ns
₫¶ t _r	$T_A = 25\%$	15	ns
toff		20	ns
ts	2.62 - 34	20	ns
tf	- Inital	10	ns
t _S	_	20	ns
	t _S	t _S —	t _S — 20

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) fT is defined as the frequency at which |hfe| extrapolates to unity.



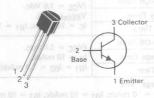
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	V _{CBO}	25	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic Ic	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	200	°C/W

MPS5172

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPS3903 for graphs.

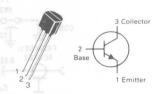
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	FIGURE 1 SWITCHING TIME				
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	Y(BR)CEO	25	16V Q	_	Vdc
Collector Cutoff Current $(V_{CB} = 25 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 25 \text{ Vdc}, I_E = 0, T_A = 100^{\circ}\text{C})$	ІСВО	=	SHS	100 10	nAdc μAdc
Collector Cutoff Current (VCE = 25 Vdc, VBE = 0)	ICES	_ ce	3.0	100	nAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	I _{EBO})=~		100	nAdc
ON CHARACTERISTICS				40 mi 4	tur 2
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	hFE 👍	100	-	500	-
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)	_	-	0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE} (sat)	-	0.75	-	Vdc
Base-Emitter On Voltage (I _C = 10 mAdc, V _{CE} = 10 Vdc)	VBE(on)	0.5	-	1.2	Vdc
SMALL SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 2.0 mAdc, V_{CE} = 5.0 Vdc)	f _T	-	120	-	MHz
Collector-Base Capacitance (V _{CB} = 0, I _E = 0, f = 1.0 MHz)	C _{cb}	1.6	_	10	pF
Small Signal Current Gain (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{fe}	100	-	750	_

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MPS5179

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH FREQUENCY TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

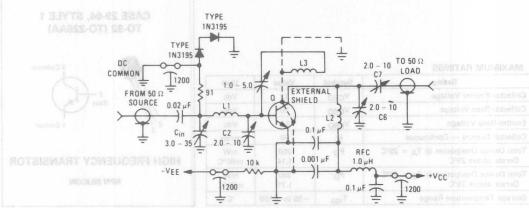
Deties O	0	Value	Unit
Rating	Symbol	value	Unit
Collector-Emitter Voltage	VCEO	12	Vdc
Collector-Base Voltage	VCBO	20	Vdc
Emitter-Base Voltage	VEBO	2.5	Vdc
Collector Current — Continuous	IC	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD 44	200	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	300 1.71	mW mW/°C
Storage Temperature Range	T _{stg}	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Min	Max	Unit
OFF CHARACTERISTICS	N. W. W. W. D. C. C.			
Collector-Emitter Sustaining Voltage (IC = 3.0 mAdc, I _B = 0)	VCEO(sus)	12	_	Vdc
Collector-Base Breakdown Voltage (IC = 0.001 mAdc, I _E = 0)	V(BR)CBO	20	_	Vdc
Emitter-Base Breakdown Voltage ($I_E=0.01$ mAdc, $I_C=0$)	V(BR)EBO	2.5	_	Vdc
Collector Cutoff Current $(V_{CB} = 15 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 15 \text{ Vdc}, I_{E} = 0, T_{A} = 150^{\circ}\text{C})$	ICBO	=	0.02 1.0	μAdc
ON CHARACTERISTICS				
DC Current Gain (IC = 3.0 mAdc, VCE = 1.0 Vdc)	hFE	25	250	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{CE} (sat)	_	0.4	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}	_	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product(1) (IC = 5.0 mAdc, V _{CE} = 6.0 Vdc, f = 100 MHz)	fT	900	2000	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 0.1 to 1.0 MHz)	C _{cb}	_	1.0	pF
Small Signal Current Gain (IC = 2.0 mAdc, VCE = 6.0 Vdc, f = 1.0 kHz)	h _{fe}	25	300	_
Collector Base Time Constant (I _E = 2.0 mAdc, V _{CB} = 6.0 Vdc, f = 31.9 MHz)	rb'C _C	3.0	14	ps
Noise Figure (See Figure 1) (I _C = 1.5 mAdc, V _{CE} = 6.0 Vdc, R _S = 50 ohms, f = 200 MHz)	NF	_	4.5	dB
Common-Emitter Amplifier Power Gain (See Figure 1) (V _{CE} = 6.0 Vdc, I _C = 5.0 mAdc, f = 200 MHz)	Gpe	15	-	dB

⁽¹⁾ f_T is defined as the frequency at which $|h_{\mbox{\it fe}}|$ extrapolates to unity.

FIGURE 1 – 200 MHz AMPLIFIER POWER GAIN AND NOISE FIGURE CIRCUIT



- L1 1-3/4 Turns, #18 AWG, 0.5" L, 0.5" Diameter
- L2 2 Turns, #16 AWG, 0.5" L, 0.5" Diameter
- 1.3 2 Turns, #13 AWG, 0.25" L. 0.5" Diameter (Position 1/4" from L2)

	L3 2 Turns, #13 AWG	6, 0.25" L, 0.5" Diameter (Position 1/4" from L2)
300		
3-1		

ution at entelowertup Last daidures unnermant aut pe beniller at +2 (A)

Rating	Symbol	Value (18	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	VCBO	30 30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	IC	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	OF °C

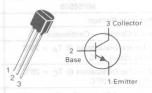
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

MPS6507

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) while seeing DCS = ATI SOLITORISTOARAMO LADMITED

Male Characteristic lodesyd		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				63	TEMPTOAR	MARIE T
Collector-Emitter Breakdown Voltage(2) (I _C = 1.0 mAdc, I _B = 0)	, MPS6513	V(BR)CEO	20	indov = Val = 0)	imitt a. Bres 5 mAde. Ig	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \ \mu Adc, I_E = 0$)		V(BR)CBO	30	- 10	al shàmi	Vdc
Emitter-Base Breakdown Voltage $(I_E = 100 \ \mu Adc, I_C = 0)$	01005 th 010	V(BR)EBO	3.0	- Veltere	edutació en	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0) (V _{CB} = 15 Vdc, I _E = 0, T _A = 60°C)		СВО	00 = 10		50 1.0	nAdc μAdc
ON CHARACTERISTICS	streeth unit			(0 =	30 Vdc, lg	- 114
DC Current Gain(2) (I _C = 2.0 mAdc, V _{CE} = 10 Vdc)		hFE	25	75	20 V <u>de. fe</u> ACTERISTN	e pay
SMALL-SIGNAL CHARACTERISTICS	,				nise 1	herid
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)		1 6889 FT 1 3889 M	700	800	gV ,a <u>h</u> Am 6	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)		C _{obo}	_	1.25	2.5	pF
Small-Signal Current Gain (I _C = 2.0 mAdc, V _{CE} = 10 Vdc, f = 44 MHz)		h _{fe}	20 (1)(5	bv 0 1 = 3:	N ,otsAm 0r) i
2) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%.		MPS6516				

Rating	Symbol	NPN	PNP	Unit
Collector-Emitter Voltage MPS6512, MPS6513 MPS6514, MPS6515 MPS6516 thru MPS6518	VCEO	30 25	40	Vdc
MPS6519		307	25	5
Collector-Base Voltage MPS6512 thru MPS6515 MPS6516 thru MPS6518 MPS6519	VCBO	40 	40 25	Vdc
Emitter-Base Voltage	VEBO	4.0	4.0	Vdc
Collector Current — Continuous	IC	100	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		25 .0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		.5	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

NPN MPS6512 thru MPS6515

PNP MPS6516 thru MPS6519

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

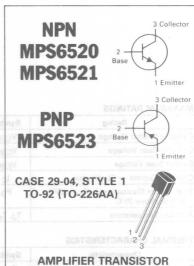
Refer to 2N4125 for graphs.

that grade cyT Character	ristic fodmy2	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				80	NA STREET	AF ARO T
Collector-Emitter Breakdown Voltage (I _C = 0.5 mAdc, I _B = 0)	MPS6512, MPS6513	V(BR)CEO	30	idown Volt = (0) —	nider Breit mAde, Ig	Vdc
	MPS6514, MPS6515		25	own Voltage	tiols and as	listor-3s lc = 1i ti
(I _C = 0.5 mAdc, I _B = 0)	MPS6516 thru MPS6518 MPS6519		40 25	aga <u>tlo</u> V m	-	
Emitter-Base Breakdown Voltage $(I_E = 1)$	10 μ Adc, I _C = 0) 10 μ Adc, I _C = 0)	V(BR)EBO	4.0 4.0		en i <u>o</u> Hon	Vdc
Collector Cutoff Current (VCB = 30 Vdc, IF = 0)		ICBO	(0)	0. TA = 6	0.05	μAdd
(V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 20 Vdc, I _E = 0)	MPS6516 thru MPS6518 MPS6519			8	0.05	A SAHO I
ON CHARACTERISTICS	1111 00010			pbV 01 = :	o.oo	0.5 = 5
DC Current Gain		hFE	80	ACTERST	NAL CHAP	3-118
$(I_C = 2.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPS6512 MPS6513 MPS6514		50 90 150	zielth -P rodu = 1 0- Vdc.	100 180 300	ranke t
	MPS6515		250	0,1 - 100	500	1 = 3 1ug
$(I_{C} = 100 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	MPS6512 MPS6513	(%)	30 60	- mail = 10 Vag	i Current (mA da , Vej	ell-Signa g = 2.0
	MPS6514 MPS6515	do ≤ 2.0°6.	90 150	1,000 to 110:	Pulse Wi	na aTrack
$(I_C = 2.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPS6516 MPS6517 MPS6518 MPS6519		50 90 150 250	=	100 180 300 500	
$(I_C = 100 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	MPS6516 MPS6517 MPS6518 MPS6519		30 60 90 150	=	=	
Collector-Emitter Saturation Voltage (IC (IC	= 50 mAdc, I _B = 5.0 mAdc) = 50 mAdc, I _B = 5.0 mAdc)	VCE(sat)	_	=	0.5 0.5	Vdo
SMALL-SIGNAL CHARACTERISTICS						
Output Capacitance (V _{CB} = 10 Vdc, I _E = (V _{CB} = 10 Vdc, I _E =		C _{obo}	_	=	3.5 4.0	pF

Rating	Symbol	NPN	PNP	Unit
Collector-Emitter Voltage MPS6520, MPS6521 MPS6523	VCEO	25 —	 25	Vdc
Collector-Base Voltage MPS6520, MPS6521 MPS6523	VCBO	40	 25	Vdc
Emitter-Base Voltage	V _{EBO}	4	.0	Vdc
Collector Current — Continuous	lc	10	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		25 .0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		.5	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to	+ 150	08 °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (Printed Circuit Board Mounting)	$R_{\theta}JA$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W



Refer to MPS3903 for NPN graphs.*

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Cha	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					the state of the s	
Collector-Emitter Breakdown Voltage (I _C = 0.5 mAdc, I _B = 0) (I _C = 0.5 mAdc, I _B = 0)	Ованив) У		V(BR)CEO	25 25	Adc. (g = 0) : Bre <u>ak</u> down	Wdc Vdc
Emitter-Base Breakdown Voltage (IE = 10 µAdc, IC = 0) (IE = 10 µAdc, IC = 0)	083(R8)V		V(BR)EBO	4.0 4.0	ide, Ig = 0) Great <u>dd</u> own \ \dc, I <u>c</u> = 0)	
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 20 Vdc, I _E = 0)	1080		ІСВО	_	0.05 0.05	μAdc
ON CHARACTERISTICS			0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	Turke Ar	A STORY	The second
DC Current Gain ($I_C = 100 \ \mu Adc$, $V_{CE} = 10 \ Vdc$) ($I_C = 2.0 \ mAdc$, $V_{CE} = 10 \ Vdc$) ($I_C = 100 \ \mu Adc$, $V_{CE} = 10 \ Vdc$) ($I_C = 100 \ \mu Adc$, $V_{CE} = 10 \ Vdc$) ($I_{C} = 2.0 \ mAdc$, $V_{CE} = 10 \ Vdc$) Collector-Emitter Saturation Voltage	39/l	MPS6520 MPS6521 MPS6520 MPS6521 MPS6523 MPS6523	hFE	100 150 200 300 150 300	400 600 — 400	000 - 100
Collector-Emitter Saturation Voltage ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)	(1681513*	MPS6530 MPS6531	VCE(sat)	(abAm 0	0.5 0.5	Vdc
SMALL-SIGNAL CHARACTERISTICS	VB(E(set)			agastic	Saturation V	TODAY S-DE
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$ $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$			C _{obo}	2011/08/11/08	3.5 3.5	pF Male pF
Noise Figure (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = Power Bandwidth = 15.7 kHz, 3.0 dE (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = Power Bandwidth = 15.7 kHz, 3.0 dE	points @ 10 Hz 10 kohms,		NF	f = 1.0 MHz f = 1.0 MHz	3.0	dB

^{*}Refer to 2N5086 for PNP graphs.



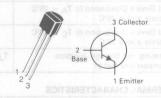
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	lc lc	0 600 881	mAdd
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625	mW
Junction Temperature	TJ, Tstg	150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	0.2	°C/mW

MPS6530 MPS6531

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N4400 for graphs.

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	fournes		313611030616	ietu/		
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	O30(A6) ^Q		V(BR)CEO	40 agalloV hw	oboles (8 ratio	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)			V(BR)CBO	60	0 = gl obAc	Vdc
Emitter-Base Breakdown Voltage ($I_B = 10 \mu Adc, I_C = 0$) ($I_B = 10 \mu Adc, I_C = 0$)	Oda(RB)V		V(BR)EBO	5.0 4.0	10 = 31 .01.0 Ado, 10 = 9)	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 40 Vdc, I _E = 0, T _A = 60°C)	083,		СВО	_	0.05 2.0	μAdc
ON CHARACTERISTICS						
DC Current Gain ($I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$)		MPS6530 MPS6531 MPS6530	hFE	30 60 40	120) = 100 100 = 2.11 p
$(I_C = 500 \text{ mAdc, } V_{CE} = 10 \text{ Vdc})$		MPS6531 MPS6530 MPS6531		90 25 50	270	c = 100 0 = 20 r
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)		MPS6530 MPS6531	VCE(sat)	n Voltage) mA dd)) mA dd)	0.5	
Base-Emitter Saturation Voltage (IC = 100 mAdc, IB = 10 mAdc)			V _{BE} (sat)	еоптаизэ	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	0.009			(seb) 001 = 1	Ø is at abV	Ven e 10
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz (V _{CB} = 10 Vdc, I _F = 0, f = 1.0 MHz			C _{obo}	1 = 100 loke - - 20 Vote Re =	5.0 7.0	er pF)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC	600	mAdd
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625	a remW
Junction Temperature	T _J , T _{stg}	150	°C

THERMAL CHARACTERISTICS

SMALL-SIGNAL CHARACTERISTICS

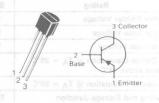
 $(V_{CB} = 10 \text{ Vdc}, I_{E} = 0, f = 1.0 \text{ MHz})$ $(V_{CB} = 10 \text{ Vdc}, I_{E} = 0, f = 1.0 \text{ MHz})$

Output Capacitance

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	W 0.2	°C/mW

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N4402 for graphs.

pF

5.0 7.0

Cobo

rint! we lift of the	acteristic	Symbol	Min Min	Max	Unit
OFF CHARACTERISTICS				ESISTICS.	DARALL FI
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	V/BRICEO	V(BR)CEO	40	ter Breekdov Arto, Ip = 0)	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	У <u>і</u> вя)сво	V(BR)CBO	40 _{mov}	Breeksown do, le = 0)	Vdc
Emitter-Base Breakdown Voltage (I _B = 10 μ Adc, I _C = 0) (I _B = 10 μ Adc, I _C = 0)		V(BR)EBO	5.0 4.0		Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0) (VCB = 30 Vdc, IE = 0, TA = 60°C) (VCB = 20 Vdc, IE = 0, TA = 60°C)	OBJ	ICBO	=	2.0	μAdc
ON CHARACTERISTICS	277		0 Vdat	1dc, VCE = 1	Am UE = yh
DC Current Gain (IC = 10 mAdc, VCE = 1.0 Vdc)	VCE(sst)	hFE	60 Am	rer Saturabo idc. l <u>a</u> = 3.0	im desal ello Im GE 118
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2 1	eodatio	90		MS12-J J-Mi San Iron Last
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)	204	VCE(sat)	(= 1 00 kHz)	/da, 8:0= 0.	Vdc V
Base-Emitter Saturation Voltage (IC = 100 mAdc, IB = 10 mAdc)	50V	V _{BE} (sat)	0 Vd e, f = d	= 91.0 .06	// Vdc
					Associated by the

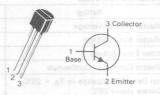
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.81	mW mW/°C
Total Device Dissipation @ T _A = 60°C	PD	Wir 210	mW
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +135	°C

THERMAL CHARACTERISTICS

Characteristic (1994)	Symbol	Max	Unit	
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	357	°C/W	

MPS6544

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSH20 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

MinU xet4 cha	racteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				SOLESHE	CHARAGO
Collector-Emitter Breakdown Voltage $(I_C = 1.0 \text{ mAdc}, I_E = 0)$	Viericeo	V(BR)CEO	45	us B <u>ru</u> akdov use 1g = 6)	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	V(BR)CRO	V(BR)CBO		dc, lg = 0)	My 1 = 3
Emitter-Base Breakdown Voltage (I _E = 10 μ Adc, I _C = 0)	V(BRIERO)	V(BR)EBO	4.0	do, lg = 01	May 0 = 8
Collector Cutoff Current (VCB = 35 Vdc, IE = 0)	oapi leao	ICBO	_	0.5	μAdc
ON CHARACTERISTICS			(1986 - AT	0 = 2 00	/ 08 - 30 \
DC Current Gain (IC = 30 mAdc, VCE = 10 Vdc)		hFE	20 A	70 = 10 SERIOS	CHARACT
Collector-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 3.0 mAdc)	and	VCE(sat)	fshy 0	0.5	Vdc
SMALL-SIGNAL CHARACTERISTICS			1.0 Vdc)	= ggV.abA	m 001 = g
Common-Emitter Reverse Transfer Cap (V _{CB} = 10 Vdc, I _C = 0, f = 100 kHz)		C _{re}	10 Velai n Voltage	0.65	1
Output Admittance (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 4	15 MHz)	Yoe	i mAdol itage	0.10	
Output Voltage (Vin(RMS) = 12 mV, f = 45 MHz)		V _{out}	1.0	Ado <u>alg</u> = 1 it CHARACT	Vuc

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	25	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	IC	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PĎ	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	O 85 10

NPN Base September 1 Emitter 3 Collector PNP Base MPS6562 Emitter CASE 29-04, STYLE 1 TO-92 (TO-226AA)

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/mW

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

CI	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					SOMESTIC	ARAMO TO
Collector-Emitter Breakdown Voltage($I_C = 10 \text{ mAdc}, I_B = 0$)	2) 030(#8) ^V		V(BR)CEO	25 nw	iliter Breakd	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	Овоглагу		V(BR)CBO	25	se Breakdow wanta le	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)			V(BR)EBO	5.0	evenidown	Vdc
Collector Cutoff Current (V _{CE} = 25 Vdc, I _B = 0)	osol		ICEO	=	100	nAdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)			ICBO	-	100	nAdc
Emitter Cutoff Current (VEB(off) = 4.0 Vdc, I _C = 0)	344		IEBO	6.0 Vdc)	100	nAdc
ON CHARACTERISTICS(2)	VCE(sat)			eganov no	HEROPAGE YOUTH	in-creation
DC Current Gain (I _C = 10 mAdc, V_{CE} = 1.0 Vdc) (I _C = 100 mAdc, V_{CE} = 1.0 Vdc) (I _C = 500 mAdc, V_{CE} = 1.0 Vdç)	(teat)36V		hFE	35 50 50	neitauts2	etnes Tolk Of = 50 DAS GAS
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)	T ₁	MPSesseA	V _{CE} (sat)	th Product 10 Vdc, f =	100 John Vote	
Base-Emitter On Voltage (I _C = 500 mAdc, V _{CE} = 1.0 Vdc)	do?	Athense, weekend	V _{BE} (on)		1.2 ea Capacitae	
SMALL-SIGNAL CHARACTERISTICS		AUYds/ABass/W/ 10	e, emitter quaries	HW 0.0 = 1	n = 31 ppv (
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f =	30 MHz)	MPSecent	SOUTHERN TO SERVICE	60	1 a Vdc, Rg	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kH	z)		C _{obo}	-	30	-
Pulse Test: Pulse Width ≤ 300 μs, D	Outy Cycle ≤ 2	APSSSOBA AIPSSSOBA, MPSGS70A	= 200 M(4z) f = 45 MHz)			

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	VCBO	20	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	lc	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

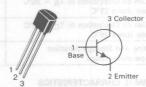
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case(1)	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

thru **MPS6570A**

CASE 29-04, STYLE 2 TO-92 (TO-226AA)

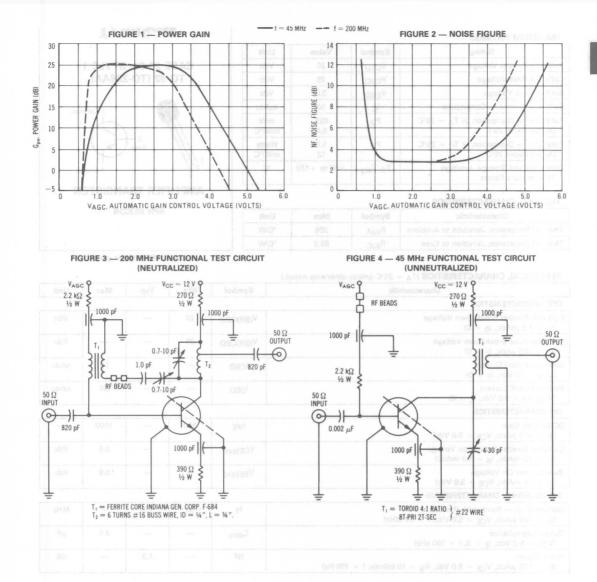


VHF TRANSISTOR

NPN SILICON

ELEC	RICAL	CHARAC	I ERISTICS	(IA	=	25°C	unless	otherwise	notea.

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS				SUITSHUE	ULANU 150
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)		V(BR)CEO	20	Ade, ig = 1	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)		V _(BR) CBO	20	p.Adc. 1g =	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)		V _{(BR)EBO}	3.0	= 57 35An	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _C = 0)		ІСВО	- (50	nAdc
ON CHARACTERISTICS				Marie and	10100000 5
DC Current Gain (I _C = 4.0 mAdc, V _{CE} = 5.0 Vdc)		hFE	20	200	tu 3 namini
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 5.0 mAdc)		V _{CE(sat)}	0.1	3.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 5.0 mAdc)		V _{BE(sat)}	(0EV 0.7	0.96	Vdc
SMALL-SIGNAL CHARACTERISTICS			(pb/ 0.1 =	mAdu, Vos	(lc = 100
Current-Gain — Bandwidth Product (IC = 4.0 mAdc, VCE = 10 Vdc, f = 100 MHz)	MPS6568A MPS6569A, MPS6570A	fT	375 300	800 800	MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$, emitter guarded	i) MPS6568A/6570A	C _{cb}	- (pb Y- 0,7 =	0.65	pF
Noise Figure ($V_{AGC} = 1.4 \text{ Vdc}$, $R_S = 50 \text{ ohms}$, $f = 200 \text{ MHz}$) ($V_{AGC} = 2.75 \text{ Vdc}$, $R_S = 50 \text{ ohms}$, $f = 45 \text{ MHz}$)	MPS6568A MPS6569A, MPS6570A	NF (SHM DE	In Product 10 Vdc. (3.3 6.0	0 = 30
FUNCTIONAL TEST			Harmin 1	Barrettos Barrettos	Square cap
Amplifier Power Gain $(V_{AGC} = 1.4 \text{ Vdc}, R_S = 50 \text{ ohms}, f = 200 \text{ MHz})$ $(V_{AGC} = 2.75 \text{ Vdc}, R_S = 50 \text{ ohms}, f = 45 \text{ MHz})$	MPS6568A MPS6569A, MPS6570A	G _{pe}	20 22.5	27 28.5	dB
Forward AGC Voltage (Gain Reduction = 30 dB, $R_S=50$ ohms, $f=200$ M (Gain Reduction = 30 dB, $R_S=50$ ohms, $f=45$ MH		VAGC	4.0 4.4 5.2	5.0 5.4 6.2	Vdc



MAXIMUM RATINGS		and the last of th	
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	VCBO	25	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	IC	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	R_{θ} JC	83.3	°C/W

MPS6571

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSA18 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Charac	teristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	20148 38	7			\$ 11.31		3	W -9
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)			47.252	V _{(BR)CEO}	20	_	T	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	1	The second	109100	V(BR)CBO	25	0.7-10	T	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)		22152 16-W E		ІСВО	13-1	4 01	50	nAdc
Emitter Cutoff Current (VEB(off) = 3.0 Vdc, I _C = 0)	X	0.00		IEBO	1-3	0140-	50	nAdc
ON CHARACTERISTICS	MAL	115			12	1		
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc)	ZL.	tin 300.0		hFE	250	<-	1000	30 19 20
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	%; 0001			V _{CE(sat)}	2-0001		0.5	Vdc
Base-Emitter On Voltage (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)				V _{BE(on)}	M 55		0.8	Vdc
SMALL-SIGNAL CHARACTERISTICS	- 4			1	+	727		
Current-Gain — Bandwidth Product (I _C = 500 μ Adc, V _{CE} = 5.0 Vdc, f =	20 MHz)			fT × N =	50	175	1 1993 <u>3 2 2 1</u> 2 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	MHz
Output Capacitance (VCB = 5.0 Vdc, IE = 0, f = 100 kHz				C _{obo}	-	-	4.5	pF
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S	= 10 kohms,	f = 100 Hz)		NF	-	1.2	-	dB

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	45	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC I	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 to + 150	or aa °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/mW

(1) R_{0JA} is measured with the device soldered into a typical printed circuit board.

MPS6576

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AUDIO TRANSISTOR

NPN SILICON

Refer to MPS3903 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Ch	aracteristic	(1)2001 nonvision a	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	rodatyd		1924-198-14-1	W.	awarnetrann.	
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	2) 030(88)V		V(BR)CEO	45 agatiov nwo	n-itter Breukde	Vdc
Collector Cutoff Current (VCB = 45 Vdc, I _E = 0)		WP58902 9052	ICBO	_	100	nAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	OSO(RS)V	MPS6801.4651 MPS6902.4652	IEBO	(i	100	nAdc
ON CHARACTERISTICS						tall to imi
DC Current Gain (IC = 1.0 mAdc, VCE = 5.0 Vdc)	California		hFE	100	300	or — II O su tocifac
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	030	Missequyessa MPseappysssz	VCE(sat)	_	0.5	Vdc
Base-Emitter On Voltage(2) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	CBO	MPS6601/6651	V _{BE(on)}	_	8.0 rent	Vdc
SMALL-SIGNAL CHARACTERISTICS		746-2000 S-000 PS			0 = 31 '00h 0	
Current-Gain — Bandwidth Product(2 (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f =			fT	100	350	MHz
Output Capacitance (VCB = 12 Vdc, I _E = 0, f = 100 kH	z)		C _{obo}	(abv 0.1 =	12	pF

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MPS6602/6652		40	ar I
Collector-Base Voltage MPS6601/6651 MPS6602/6652	VCBO	25 30	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	Ic	1000	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

OFF CHARACTERISTICS

SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product

 $(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 30 \text{ MHz})$

Characteristic Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _B JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) R₀JA is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic

MPS6602

PNP MPS6651 MPS6652



CASE 29-04, STYLE 1 TO-92 (TO-226AA)

Symbol

fT

100



Unit

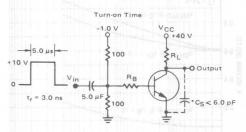
MHz

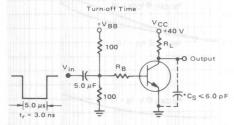
AMPLIFIER TRANSISTOR

Max

Collector-Emitter Breakdown Voltage			V(BR)CEO		e gi shami	Vdc
(I _C = 1.0 mAdc, I _B = 0)		MPS6601/6651 MPS6602/6652		25 40	atori Currant	Collector C
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	cest	MPS6601/6651 MPS6602/6652	V(BR)CBO	25 40	off Concerns	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	garl.		V(BR)EBO	4.0	nis D	Vdc
Collector Cutoff Current (V _{CE} = 25 Vdc, I _B = 0) (V _{CE} = 30 Vdc, I _B = 0)	VCEsses	MPS6601/6651 MPS6602/6652	ICEO	ion Vallage ion Vallage 1.0 m&det		μAdc
Collector Cutoff Current (V _{CB} = 25 Vdc, I _E = 0) (V _{CB} = 30 Vdc, I _E = 0)		MPS6601/6651 MPS6602/6652	ІСВО	42) • 5:0 ½dq) : 110 kg (200)	0.1 0.1	μAdc
ON CHARACTERISTICS				Produces	newbasia — n	Aument Cal
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1000 mAdc, V _{CE} = 1.0 Vdc)	odo ^D		(hFE)07	50 50 30	actuante 2 Vdarig = 1	Ot - <u>La</u> ll Jedu Vegu HOW
Collector-Emitter Saturation Voltage (I _C = 1000 mAdc, I _B = 100 mAdc)			VCE(sat)	Tell Pop - 1	0.6	Vdc
Base-Emitter On Voltage (Ic = 500 mAdc, VcE = 1.0 Vdc)			V _{BE(on)}		1.2	Vdc

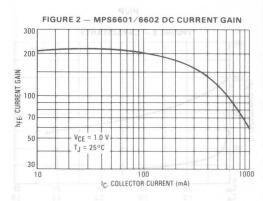
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)		C _{obo}	-	30	pF
SWITCHING CHARA	CTERISTICS				
Delay Time		t _d	_	25	ns
Rise Time	Time $I_{B1} = 50 \text{ mAdc},$ $t_p \ge 300 \text{ ns Duty Cycle})$	t _r	_	30	ns
Storage Time		t _S	_	250	ns
Fall Time		tf	_	50	ns



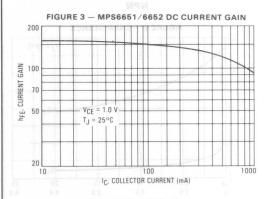


*Total Shunt Capacitance of Test Jig and Connectors For PNP Test Circuits, Reverse All Voltage Polarities





PNP





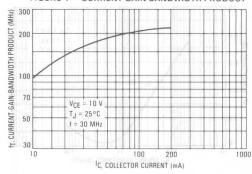
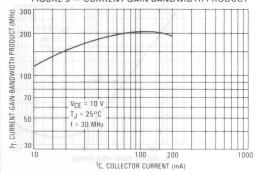
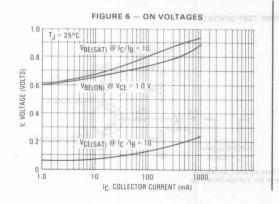
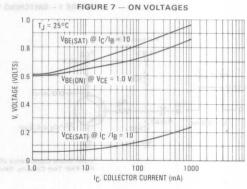
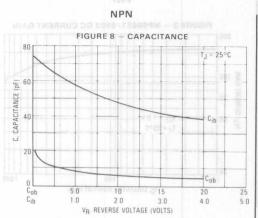


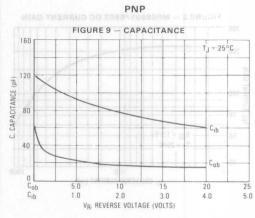
FIGURE 5 - CURRENT GAIN BANDWIDTH PRODUCT

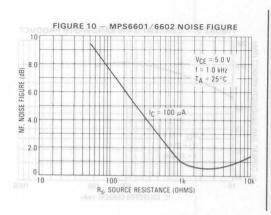


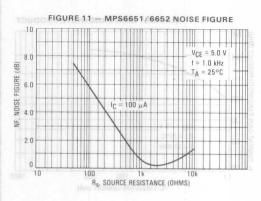




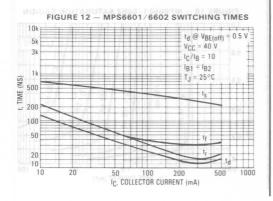


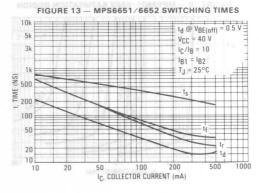


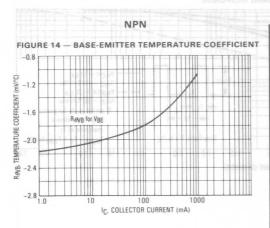


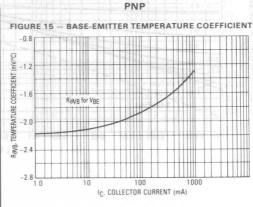


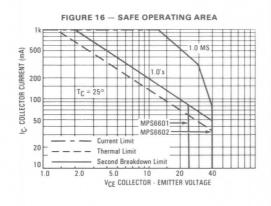
NPN MPS6601, MPS6602, PNP MPS6651, MPS6652

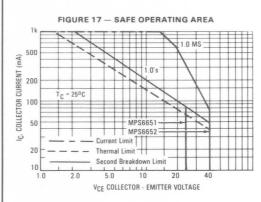


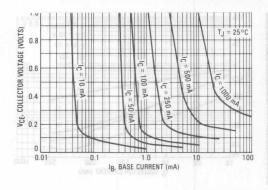


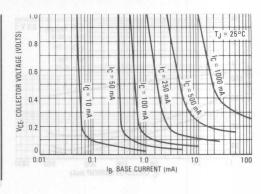




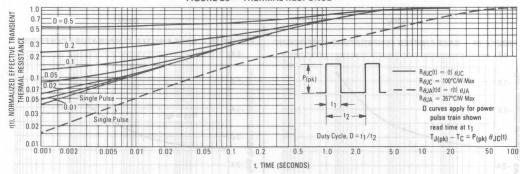




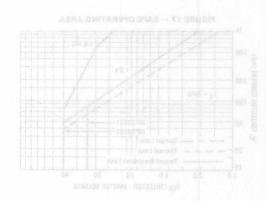












Collector-Emitter Voltage MPS6714 MPS6715	VCEO	30	Vdc
Collector-Base Voltage MPS6714 MPS6715	VCBO	40 40 50	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic .	1.0	Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _B JC	50	°C/W
Thermal Resistance, Junction to Ambient	R _O JA	125	°C/W

MPS6715

CASE 29-03, STYLE 1 TO-92 (TO-226 AE)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSW01 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)				
Surgery of Min Max Units	Combat	63 A41-	 11.74	٦

SinU zaM nitri Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CTERISTICS	F CHARA
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	OSO(BB)V	MPS6714 MPS6715	V(BR)CEO	30 40	itter Breakdov nAdc <u>a</u> = 0	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	V(BR)CBO	MPS6714 MPS6715	V(BR)CBO	40 50	se Breakdown u.Adc <u>. 1_E = 0</u>)	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	V(вянево		V(BR)EBO	5.0	Brea <u>kd</u> awn V Ado, IG = 0)	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0)	083	MPS6714 MPS6715	СВО	_	9 = 0.1 obV 0 = 0.1 obV 0 = 0.1	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)	ceal		I _{EBO}	_	0.1 00 V	μAdc
ON CHARACTERISTICS(1)	- m1 - m2 - m2 - m2 - m2 - m1				ri eleamosta	MARARO I
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1000 mAdc, V _{CE} = 1.0 Vdc)	397		hFE	60 50	= 30 <u>V</u> 36A1	i fren <u>u (</u>) n 06 = 19 1085 = 1
Collector-Emitter Saturation Voltage (I _C = 1000 mAdc, I _B = 100 mAdc)	VCE(sat)		V _{CE(sat)}	ege <u>flo</u> V as 0 mAdo)	0.5	Vdc
Base-Emitter On Voltage (IC = 1000 mAdc, VCE = 1.0 Vdc)	VBE(on)		V _{BE} (on)	(abV 0.1	1.2 90 V. 25 A.m	Vdc
SMALL-SIGNAL CHARACTERISTICS				2511 BIRDI	DAMAHO JAF	ENS JUST
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	do ³		C _{cb}	HIM 0.1 = 1	30	pF
Small-Signal Current Gain (IC = 50 mAdc, VCE = 10 Vdc, f = 20	O MHz)		h _{fe}	2.5	25	61 <u>1-5</u> 1gna 760

⁽¹⁾ Pulse Test: Pulse Width \leq 30 μ s, Duty Cycle \leq 2.0%.

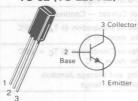
WAXINOW RATINGS					
Rating	Symbol	MPS6516	MPS6517	Unit	
Collector-Emitter Voltage	VCEO	60	80	Vdc	
Collector-Base Voltage	VCBO	60	80	Vdc	
Emitter-Base Voltage	V _{EBO} 5.0		.0	Vdc	
Collector Current — Continuous	Ic	500		mAdc	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0		Watt mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20		Watts mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150		°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPS6716 MPS6717

CASE 29-03, STYLE 1 TO-92 (TO-226 AE)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSW05 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

skell water Char	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					eogenes :	DEF CHARAC
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, _B = 0)	V(BR)CEQ	MPS6716 MPS6717	V(BR)CEO	60 80	tter Brasido Adc. (5 = 0)	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	Viskicso	MPS6716 MPS6717	V(BR)CBO	60 80	a Brazidown Adc. <u>ig</u> = 0	Vdc 001 = 01
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	оваква)У		V(BR)EBO	5.0	Breef John V	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0)	oabi	MPS6716 MPS6717	СВО	_	0.1 0.1 0.1	μAdc (1d 04 = 80V) 08 = 80V
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)	083		IEBO	-	10 10 10 10 10 10 10 10 10 10 10 10 10 1	μAdc
ON CHARACTERISTICS(1)					(*)8391349337	DATIANO M
DC Current Gain (I _C = 50 mAdc, V _{CE} = 1.0 Vdc) (I _C = 250 mAdc, V _{CE} = 1.0 Vdc)	314		hFE	80 50	250	0 0 0 m ent 0 (10 = 138 of 100)
Collector-Emitter Saturation Voltage (I _C = 250 mAdc, I _B = 10 mAdc)	VCE/sat)		VCE(sat)	n Voitagei	0.5	Vdc
Base-Emitter On Voltage (I _C = 250 mAdc, V _{CE} = 1.0 Vdc)	¥9E(on)		V _{BE(on)}	(abV 0.1 =	apa1.2/ no	Vdc
SMALL-SIGNAL CHARACTERISTICS				BOTTERRETTOR	DARAHO LA	ODIS-LIAND
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	Cob		C _{cb}	SHN 0.1 = 1	30	ose pFolic
Small-Signal Current Gain (IC = 200 mAdc, VCF = 5.0 Vdc, f =	20 MHz)		h _{fe}	2.5	25	is: gi c-lism

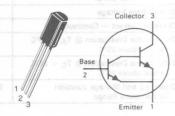
Rating	Symbol	MPS6724	MPS6725	Unit
Collector-Emitter Voltage	VCES	40	50	Vdc
Collector-Base Voltage	VCBO	50	60	Vdc
Emitter-Base Voltage	VEBO	38V 1	2 0.8	Vdc
Collector Current — Continuous	Ic	obA10	000	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	778 V4 1	270	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	avisWa2		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	+ 150 + 0	36 °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPS6724 MPS6725

CASE 29-03, STYLE 1 (TO-226 AE)



DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N6426 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CTEMBTICS	AGLARIO -
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	V(art)CEO	MPS6724 MPS6725	V(BR)CES	40 50	hier Breakdo sado, ig = 0	Vdc
Collector-Base Breakdown Voltage (I _C = 1.0 μAdc, I _E = 0)	У(вн)сво	MPS6724 MPS6725	V(BR)CBO	50 60	se Breakdows uAdo <u>tę</u> – C	
Emitter-Base Breakdown Voltage (I _E = 10 μ Adc, I _C = 0)	063(86) ^V		V _{(BR)EBO}	12	Breaktown Ade, irr = 0	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 40 Vdc, I _E = 0)	leso	MPS6724 MPS6725	ІСВО	=	0 = 100 bV 0 = 100 bV	nAdc
Emitter Cutoff Current (VEB = 10 Vdc, I _C = 0)			IEBO	-	100	nAdc
ON CHARACTERISTICS(1)			the property of the second		neorranar	MARAHO
DC Current Gain (I _C = 200 mAdc, V _{CE} = 5.0 Vdc) (I _C = 1000 mAdc, V _{CE} = 5.0 Vdc)	344		hFE	25,000 4,000	40,000	0 ina 0, 601 100 1001 +
Collector-Emitter Saturation Voltage (I _C = 1000 mAdc, I _B = 2.0 mAdc)	Vestant		V _{CE(sat)}		iter 1.5 seni	Vdc
Base-Emitter On Voltage (I _C = 1000 mAdc, V _{CE} = 5.0 Vdc)	Vacion		V _{BE} (on)	labV 0.1	808 2.0 nO	Vdc
SMALL-SIGNAL CHARACTERISTICS				removice	DABARO JAK	ERE-LAN
Current-Gain — Bandwidth Product (I _C = 200 mAdc, V _{CE} = 5.0 Vdc, f =	100 MHz)		fT	100	1000 3 sa	
Collector-Base Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MHz)	opt		C _{cb}	1.0 Vdc. (=)	unD 10 muD	pF

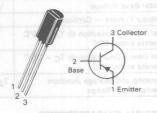
Rating	Symbol	Value	Unit
Collector-Emitter Voltage MPS6726 MPS6727	VCEO	30 40	Vdc
Collector-Base Voltage MPS6726 MPS6727	VCBO	40 50	Vdc
Emitter-Base Voltage	VEBO	5.0	ST Vdc
Collector Current — Continuous	Ic	DAM 1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to + 150	or c°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	○ °C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	W/O 125	%C/W

MPS6726 MPS6727

CASE 29-03, STYLE 1 TO-92 (TO-226 AE)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to MPSW51 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Maki waski with Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					SOLIGNALO	ASSESSED AT
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	VIBRICES	MPS6726 MPS6727	V(BR)CEO	30 40	nede <u>ig</u> = 0	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	OBD(RE)V	MPS6726 MPS6727	V(BR)CBO	40 50	на Втев коючі (Аск. <u>Ів</u> . = .0)	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μ Adc, I _C = 0)			V _{(BR)EBO}	5.0	Mag, Ig = 0)	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0)	OBO	MPS6726 MPS6727	СВО		0 = 0.1 abV 0 = 0.1 abV	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)			IEBO	_	0.1	μAdc
ON CHARACTERISTICS(1)					(r) Hort Ento (N CHARLO
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1000 mAdc, V _{CE} = 1.0 Vdc)	344		hFE	60 50	250	. Egmen ((c = 200 (c = 1500
Collector-Emitter Saturation Voltage (I _C = 1000 mAdc, I _B = 100 mAdc)	VCE(sat)		V _{CE} (sat)	n Voltage 2.0 mAdo)	0.5	Vdc
Base-Emitter On Voltage (I _C = 1000 mAdc, V _{CE} = 1.0 Vdc)	(no)38V		V _{BE} (on)	5.0 Vdet	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS				RINTERS	DAHAHU JAL	L top ALIMIN
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	77		Ccb	Product 8.0 Vds, f =	30	pF
Small-Signal Current Gain (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 2	0 MHz)		h _{fe}	2.5	25	V _{CB} = 10

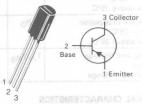
MAXIMOM HATHING				
Rating	Symbol	MPS6728	MPS6729	Unit
Collector-Emitter Voltage	VCEO	60	80	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	500		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPS6728 MPS6729

CASE 29-03, STYLE 1 TO-92 (TO-226 AE)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to MPSW55 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) W1970 seeing 0781 = ATI 801T8IR3T0ARAH0 JAO1813119

	Chara	acteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						renterios	MARAHO 1
Collector-Emitter Breakdown Vo	oltage(1)	Visniceo	MPS6728 MPS6729	V _{(BR)CEO}	60 80	ter Breatdov vdc, l <u>e_</u> = 0) —	Vdc
Collector-Base Breakdown Volta (I _C = 100 μ Adc, I _E = 0)	age	O83(86)V	MPS6728 MPS6729	V(BR)CBO	60 80	Brea <u>kd</u> own) Ado, <u>le</u> = 0)	Vdc
Emitter-Base Breakdown Voltag ($I_E = 10 \mu Adc, I_C = 0$)	e		MPSG733	V _{(BR)EBO}	5.0	_	Vdc
Collector Cutoff Current (VEB = 5.0 Vdc, IC = 0)	9.8	O83(88)V		IEBO	- aftend	10 10	μAdc
Emitter Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0)		083	MPS6728 MPS6729	СВО	_	0.1	μAdc
ON CHARACTERISTICS(1)		rami -				Current	HotuD raite
DC Current Gain (I _C = 50 mAdc, V _{CE} = 1.0 V _C (I _C = 250 mAdc, V _{CE} = 1.0 V _C		005		hFE	80 50	250	O.O gg)
Collector-Emitter Saturation Vo		345		V _{CE(sat)}	TobV 01	0.5	Vdc
Base-Emitter On Voltage (IC = 250 mAdc, VCE = 1.0 \	/dc)	(tee)30V		V _{BE(on)}	y Voltage	1,2	Vdc
SMALL-SIGNAL CHARACTERIS	TICS	i canV		7-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1		abstloV no) sent da si
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1	1.0 MHz)	1130720		C _{cb}	- LabV 0	30	m opF
Small-Signal Current Gain (IC = 200 mAdc, VCE = 5.0 V	Vdc, f = 2	20 MHz)		h _{fe}	2.5	25	med Total

Rating	Symbol	MPS6735	MPS6734	MPS6733	Unit
Collector-Emitter Voltage	VCEO	300	250	200	Vdc
Collector-Base Voltage	VCBO	300	250	200	Vdc
Emitter-Base Voltage	VEBO		6.0	14688738	Vdc
Collector Current — Continuous	lc		300	G8	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		1.0	6.	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		2.5	0. 0. a	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}		-55 to +15	00 000	°C

THERMAL CHARACTERISTICS

THE TWAL CHARACTERIOTICS						
Characteristic	Symbol	Max	Unit			
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W			
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W			

MPS6733 MPS6734 MPS6735

CASE 29-03, STYLE 1 TO-92 (TO-226 AE)



HIGH VOLTAGE TRANSISTOR

NPN SILICON

Refer to MPSW42 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

sigil selfs advi	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					container	PECHALACT
Collector-Emitter Breakdown Voltag (I _C = 10 mAdc, I _B = 0)	e(1) 030/89/V	MPS6735 MPS6734 MPS6733	V(BR)CEO	300 250 200	tor Bresidoya Adc. (5 = 9)	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	Coultai.	MPS6735	V _(BR) CBO	300	(0 = g) ,ob.	
		MPS6734 MPS6733		250 200	recedeway Vo	ersBeathi
Emitter-Base Breakdown Voltage (I _E = 100 μ Adc, I _C = 0)	0.63		V _{(BR)EBO}	6.0	in Current	Vdc
Collector Cutoff Current $(V_{CB} = 260 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 200 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 160 \text{ Vdc}, I_{E} = 0)$	osal	MPS6735 MPS6734 MPS6733	ІСВО	Ξ		μAdc 68 = 80 08 = 80
Emitter Cutoff Current (VEB = 6.0 Vdc, I _C = 0)			IEBO	_	0.1	μAdc
ON CHARACTERISTICS					out vice = 10	Am Jo = J
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	(ma)33V		hFE	25 40		timi 3- 101 091
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	VBE(on)		VCE(sat)	(55 V 0.	2.0	Vdc
Base-Emitter On Voltage (IC = 20 mAdc, VCE = 10 Vdc)	6,5		V _{BE} (on)	0.01611	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	3			(\$2100 0.7	1,0 × 31,00	A 01 = 1134
Current-Gain — Bandwidth Product $(I_C = 10 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f)$			(Terri de	50	200	MHz
Collector-Base Capacitance (VCB = 20 Vdc, I _E = 0, f = 1.0 N	IHz)		C _{cb}	Sho 'se' one	3.0	pF

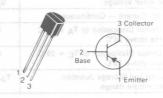
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	rieti 40	Vdc
Collector-Base Voltage	VCBO	obV 40	□ Vdc
Emitter-Base Voltage	VEBO	ob V 5.0	₩ Vdc
Collector Current — Continuous	Ic	abV200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	5.0	mW/°C
Total Device Dissipation @ T _C = 60°C	PD	450	0.8mW
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2 1.5 2 12	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	+ of °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS8093

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N4402 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

		Cha	racteristic	Symbol	Min	Max	Unit	
OFF CHARACT	TERISTICS					TERRITIOS	MARANO FE	
Collector-Emit	ter Breakdown Adc)	Voltage	V(SR)CEO	V(BR)CEO	Clag 40 / m	tter B ro akdo Add, Ig = 0)	Vdc	
Collector-Base (I _C = 100 μ	Breakdown Vo	oltage	cso	V(BR)CBO	40	ofi Co m ent Vdo, Ig = 6)		
Emitter-Base E	Breakdown Vol Adc)	tage	paal	V(BR)EBO	5.0	Vdc. <u>la</u> = 0) f Current	Vdc	
Collector Cuto (V _{CB} = 20 \				ICBO	_	100	nAdc	
Emitter Cutoff (V _{BE} = 3.0		250	344	IEBO	5.0 Vde)	100 nis = 30V Job	nAdc	
ON CHARACT	TERISTICS		Variani			Sn Voltage	161711113-0-20	
DC Current Ga (I _C = 50 mA	ain Adc, V _{CE} = 2.0	Vdc)		hFE	100	300	1001 <u>-</u> 10 1018 JJA'-8	
	ter Saturation Adc, $I_B = 5.0$ n		Cobo	VCE(sat)	1 = 1.0 MHz	0.25	Vdc	
Base-Emitter ((I _C = 50 mA	On Voltage Adc, V _{CE} = 2.0) V)	de	V _{BE(on)}	0.0 (= 1.0 MHz)	Capa 0.f ance Vdc. lg = 0		

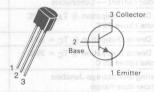
MAXIMOM NATINGS			
Rating	Symbol	Value	0 Unit
Collector-Emitter Voltage	VCEO	abV 40	○ Vdc
Collector-Base Voltage	VCBO	60	0.3 Vdc
Emitter-Base Voltage	VEBO	50 A 6.0	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	+ 01 °C -

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

MPS8097

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSA18 for graphs.

sind xaW - nW Char	acteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				80(YE)REE	TAMES T
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	Q30(88)V	V(BR)CEO	40	tter B <u>re</u> akdov Ado)	Vdc
Collector Cutoff Current (VCB = 40 Vdc, IE = 0)	V(BR)CBG	ICBO	Voltage	nwoblee18 e	nAdc
(V _{CB} = 60 Vdc, I _E = 0)	ORRESEV		- epstio	/10	μAdc
Emitter Cutoff Current (VBE = 6.0 Vdc, IC = 0)		IEBO	- -	20 (SDA)	nAdc
ON CHARACTERISTICS(2)					VCB = 20
DC Current Gain (I _C = 100 μAdc, V _{CE} = 5.0 Vdc)	083	hFE	250	700	idte <u>r (</u> 0. 18fi) Veg = 3.0
Base-Emitter On Voltage (I _C = 100 μAdc, V _{CE} = 5.0 Vdc)	asi	V _{BE(on)}	0.45	0.65	Vdc
SMALL-SIGNAL CHARACTERISTICS			laby 0.1	Ada, Vog F .	
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	VCE(earl)	C _{obo}		ther \$0.4 restic	
Emitter-Base Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MHz)	(no)\$6 ^V	C _{eb}	(V 0.8	On V 01998	pF pF
Small-Signal Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, f = 1	.0 kHz)	h _{fe}	250	800	_
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S =	= kΩ, f = 10 Hz to 15.7 kHz)	NF		2.0	dB
Equivalent Short Circuit Noise Voltage (I _C = 100 μAdc, V _{CF} = 5.0 Vdc, R _S =	= 10 k Ω , f = 100 Hz, Bw = 1.0 Hz)	en	-	32	nV/√Hz

⁽¹⁾ $R_{\theta,JA}$ is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%.

Rating	Symbol		MPS8599	Unit
Collector-Emitter Voltage	VCEO	60	80	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
- 1 () **	nIV -		MPS8598 MPS8599	
Emitter-Base Voltage	VEBO	6.0	5.0	Vdc
Collector Current — Continuous	IC	0 8 5	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	and the same and the	.5 2.0	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPS8099



P | 598 | 599 *

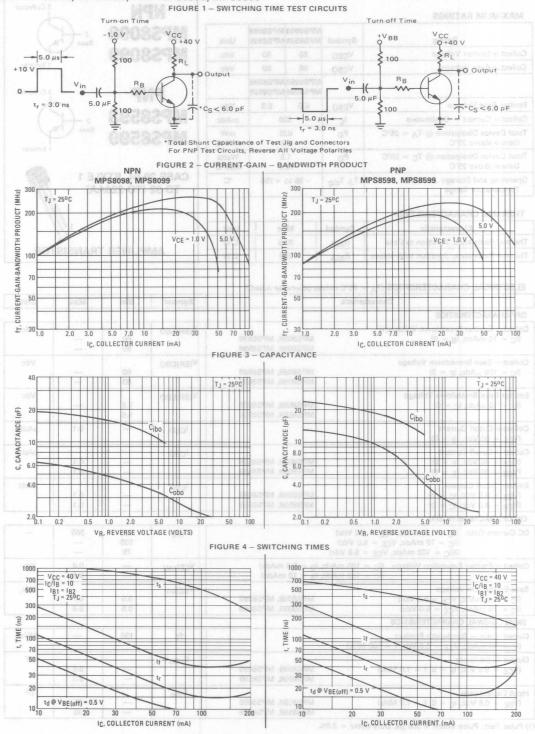


CASE 29-04, STYLE 1 TO-92 (TO-226AA)

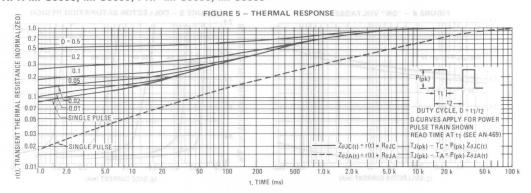


AMPLIFIER TRANSISTOR

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	MPS8098, MPS8598 MPS8099, MPS8599	V(BR)CEO	60 80	2.0 3.0	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	MPS8098, MPS8598 MPS8099, MPS8599	V(BR)CBO	60 80	mĒ	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	MPS8098, MPS8099 MPS8598, MPS8599	V(BR)EBO	6.0 5.0		Vdc
Collector Cutoff Current (VCE = 60 Vdc, I _B = 0)		ICEO		0.1	μAdd
Collector Cutoff Current (VCB = 60 Vdc, IE = 0) (VCB = 80 Vdc, IE = 0)	MPS8098, MPS8598 MPS8099, MPS8599	ІСВО		0.1 0.1	μAdd
Emitter Cutoff Current (VEB = 6.0 Vdc, IC = 0) (VEB = 4.0 Vdc, IC = 0)	MPS8098, MPS8099 MPS8598, MPS8599	IEBO		0.1 0.1	μAdd
ON CHARACTERISTICS(1)	100 100	5.0 10 20	0.5 6.1	6.0 8.0	181
DC Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ $(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ $0(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	FIGURE 4 - SWITCHING TIMES	2 hFE 3 324	100 100 75	300 — —	_
Collector-Emitter Saturation Voltage ($I_C = 100 \text{ mAc}$) ($I_C = 100 \text{ mAc}$)	lc, lg = 5.0 mAdc) lc, lg = 10 mAdc)	VCE(sat)	421	0.4	Vdc
Base-Emitter On Voltage (IC = 1.0 mAdc, VCE = 5.0 Vdc) (IC = 10 mAdc, VCE = 5.0 Vdc)	MPS8098, MPS8598 MPS8099, MPS8599	V _{BE} (on)	0.5 0.6	0.7 0.8	Vdc
SMALL-SIGNAL CHARACTERISTICS	1000				- 9%
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	(0) E	fŢ	150		MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	MPS8098, MPS8099 MPS8598, MPS8599	C _{obo}	1=	6.0 8.0	pF
Input Capacitance (V _{BE} = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	MPS8098, MPS8099 MPS8598, MPS8599	C _{ibo}	4	25 30	pF



NPN MPS8098, MPS8099, PNP MPS8598, MPS8599 02225M , 200225M 9MF , 200225M , 200225M , 200225M , 200225M





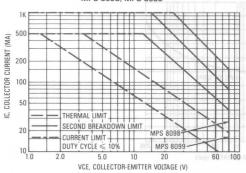
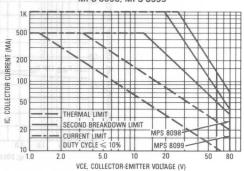
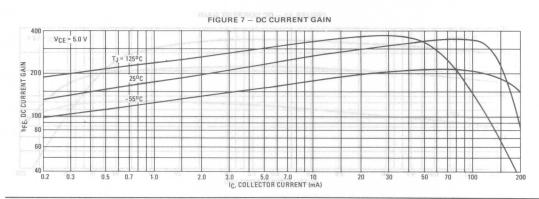


FIGURE 6—ACTIVE REGION, SAFE OPERATING AREA SHART HERE 6—ACTIVE REGION, SAFE OPERATING AREA MPS 8598, MPS 8599

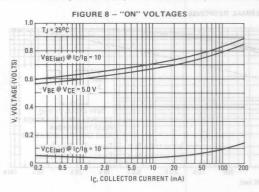


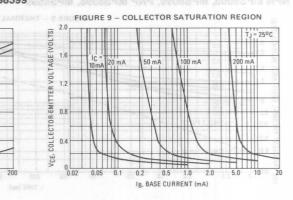
MPS8098, MPS8099

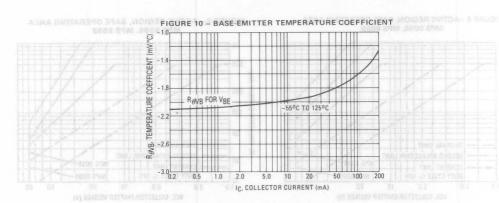


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

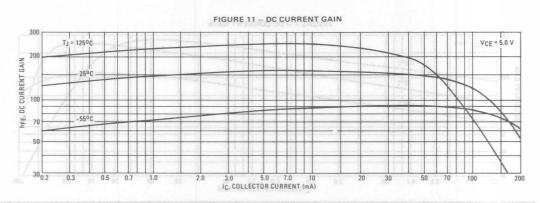
2



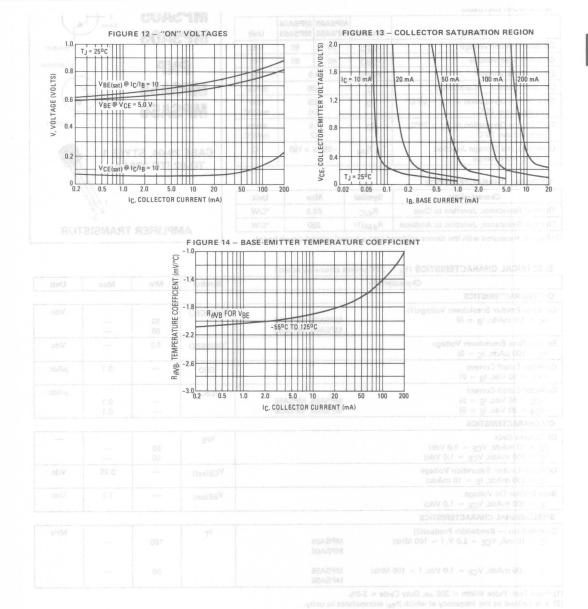




MPS8598, MPS8599



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

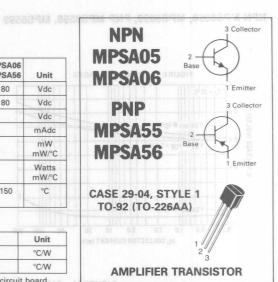


MOISSE MO Rating AS ROTHELLO	Symbol		MPSA06 MPSA56	Unit
Collector-Emitter Voltage	VCEO	60	80	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	4	.0	Vdc
Collector Current — Continuous	lc	5	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1000	.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to	o +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.



ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS			ži.		
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	MPSA05, MPSA55 MPSA06, MPSA56	V(BR)CEO	60 80	=	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)		V(BR)EBO	4.0	-	Vdc
Collector Cutoff Current (V _{CE} = 60 Vdc, I _B = 0)		ICEO	5 5 -	0.1	μAdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 80 Vdc, I _E = 0)	MPSA05, MPSA55 MPSA06, MPSA56	СВО	=	0.1 0.1	μAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 10 mAdc, V_{CE} = 1.0 Vdc) (I _C = 100 mAdc, V_{CE} = 1.0 Vdc)		hFE	50 50	_	_
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)		VCE(sat)		0.25	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)		V _{BE(on)}	-	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (I _C = 10 mA, V _{CE} = 2.0 V, f = 100 MHz)	MPSA05 MPSA06	fT	100	-	MHz
$(I_{C} = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, f = 100 \text{ MHz})$	MPSA55 MPSA56		50	-	

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ fT is defined as the frequency at which |hfe| extrapolates to unity.

FIGURE 1 - SWITCHING TIME TEST CIRCUITS

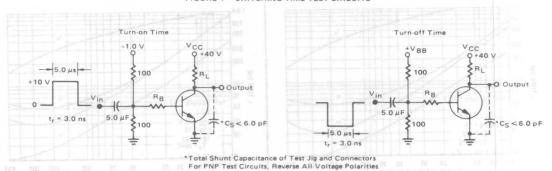


FIGURE 2 - CURRENT-GAIN-BANDWIDTH PRODUCT

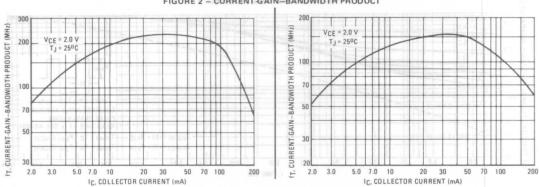
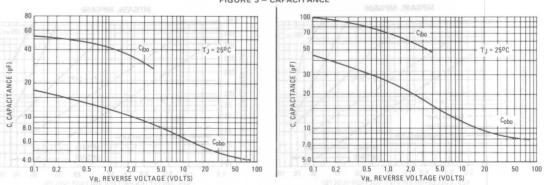
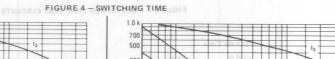
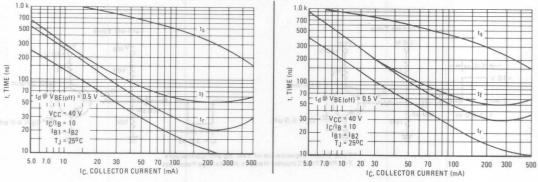


FIGURE 3 - CAPACITANCE







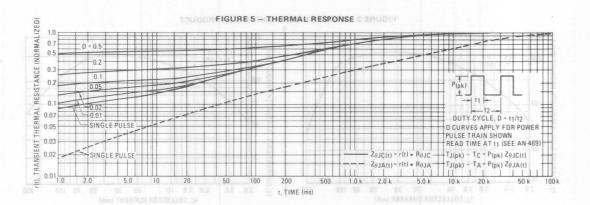
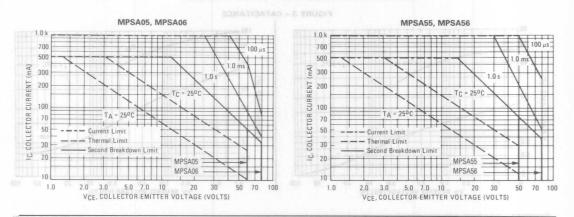
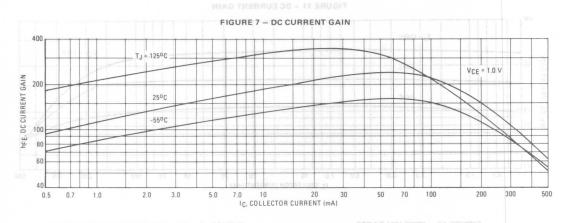
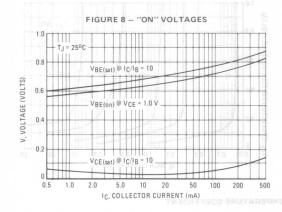


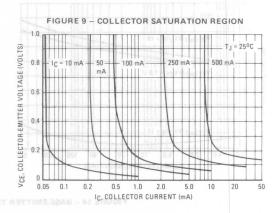
FIGURE 6 - ACTIVE - REGION SAFE OPERATING AREA



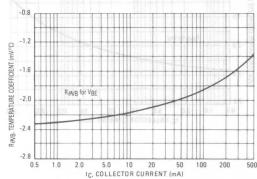
NPN MPSA05, MPSA06











PNP MPSA55, MPSA56

FIGURE 11 - DC CURRENT GAIN

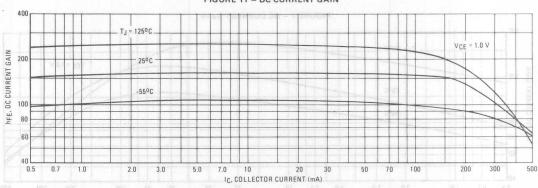


FIGURE 12 - "ON" VOLTAGES

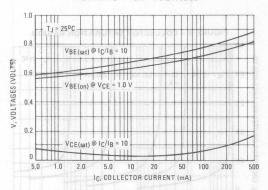


FIGURE 13 - COLLECTOR SATURATION REGION

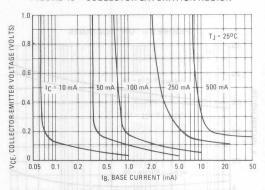
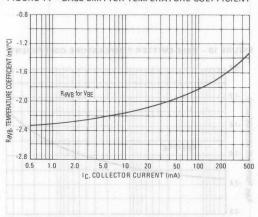


FIGURE 14 - BASE-EMITTER TEMPERATURE COEFFICIENT



MPSA13 MPSA14

CASE 28-04, STYLE

MAXIMUM RATINGS

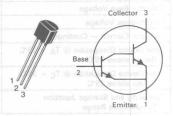
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCES	20 0.3	Vdc
Emitter-Base Voltage	VEBO	10	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	R ₀ JA	200	°C/W

MPSA12

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N6426 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Mad Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				80173	BRACTERE	PD 4-10
Collector-Emitter Breakdown Voltage (IC = 100 μAdc, IB = 0)		V(BR)CES	20	r ow st alser (g = 0)	:-En ric er B 100 uAdic,	Vdc
Collector Cutoff Current (VCB = 15 Vdc, IE = 0)		ІСВО	_		30 Vulc.	nAdc
Collector Cutoff Current (VCE = 15 Vdc, VBE = 0)		ICES	_		100 mg	nAdc
Emitter Cutoff Current (V _{EB} = 10 Vdc, I _C = 0)		IEBO		t H eort	100	nAdc
ON CHARACTERISTICS 0000	MPSATS		(ab)	/ 0.8 - 93 ⁾	70 mAde, V	+1311
DC Current Gain (IC = 10 mAdc, VCE = 5.0 Vdc)	ALASSM	hFE	20,000	-	-	_
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 0.01 mAdc)	MRSATA	V _{CE(sat)}	-100**	Die _30*	1.0	Vdc
Base-Emitter On Voltage (IC = 10 mAdc, VCF = 5.0 Vdc)		VBE	- TobA	n f.O = gi	2041.400	Vdc

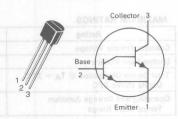
MAXIMUM RATINGS		the later of the	
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCES	30	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	10	Vdc
Collector Current — Continuous	I _C	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D	1.5 01 12 aca	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta}JC$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPSA13 MPSA14

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N6426 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) 10 about 2725 = ATI BOTTERSTOARAND JACKSTOBLES

MeU xaM gy7 Chara	cteristic (Symbol	Min	Max	Unit
OFF CHARACTERISTICS				61	RACTERISTN	WD TRO
Collector-Emitter Breakdown Voltage (I _C = 100 µAdc, I _B = 0)	ViBRICES		V(BR)CES		Emitt <u>ar</u> Breel 00 aAde, ig	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	060		ІСВО	- (0	100 luce	nAdc
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)			IEBO	(0 =	100	nAdc
ON CHARACTERISTICS(1)					Memory Current	Emitter C
DC Current Gain (IC = 10 mAdc, VCE = 5.0 Vdc)		MPSA13	hFE	5000	STABLETTOAS	AHO MO
20,000		MPSA14		10,000	tilaĐ tr	DC Curre
(I _C = 100 mAdc, V _{CE} = 5.0 Vdc)		MPSA13 MPSA14		10,000 20,000	0 mAdo, Ves brain <u>er</u> Satur	Hg. = 1 Collector
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 0.1 mAdc)	38V		VCE(sat)	95	1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)			VBE	1000	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 10	0 MHz)		fT	125	-	MHz

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ $f_T = |h_{fe}| \cdot f_{test}$.

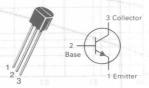
Symbol	MPS-A16 MPS-A17		Unit
VCEO	40) A 29M	Vdc
VEBO	12	15	Vdc
IC	100		mAdc
PD	625 5.0		mW mW/°C
PD	1.5 12		Watt mW/°C
TJ, T _{stg}	-55 to +150		°C
	VCEO VEBO IC PD	VCEO 44 VEBO 12 1 IC 10 PD 62 5. PD 1.	VCEO 40 VEBO 12 15 IC 100 PD 625 5.0 PD 1.5 12

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W

MILDATI

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

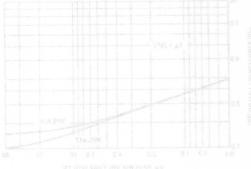


SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		3005 = A			
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	N. S.	V(BR)CEO	40		Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	MPS-A16 MPS-A17	V(BR)EBO	12 15	TIA 29M	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	- 8.0 By	ICBO		100	nAdc
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)	4. 0	I _{EBO}	8176	100	nAdc
ON CHARACTERISTICS			HILL		1.0
DC Current Gain (I _C = 5.0 mAdc, V _{CE} = 10 Vdc)	0.7 0.7 0.7	8.EhFE	200	600	,
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		V _{CE(sat)}	_	0.25	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product $(I_C = 5.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz})$	MPS-A16 MPS-A17	fT	100 80	_	MHz
Output Capacitance (VCB = 10 Vdc, IF = 0, f = 100 kHz)	TOURS	C _{obo} AA	H-RAD-TH	4.0	pF



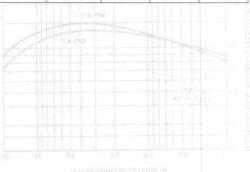
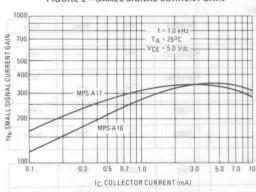


FIGURE 1 - DC CURRENT GAIN



FIGURE 2 - SMALL SIGNAL CURRENT GAIN



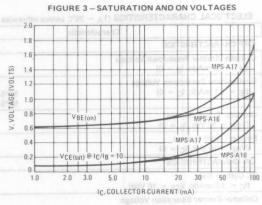


FIGURE 4 - CURRENT-GAIN-BANDWIDTH PRODUCT

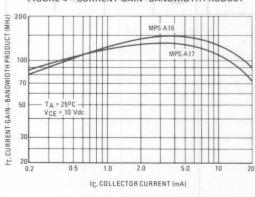
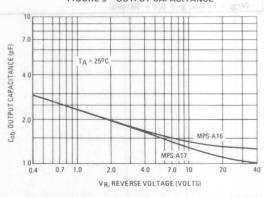


FIGURE 5 - OUTPUT CAPACITANCE



Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	45	Vdc
Emitter-Base Voltage	VEBO	6.5	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

MPSA18

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



LOW NOISE TRANSISTOR

NPN SILICON

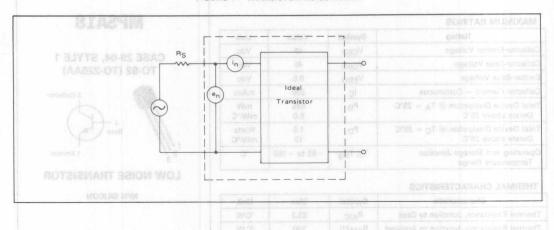
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, IB = 0)	V(BR)CEO	45			Vdc
Collector-Base Breakdown Voltage (I _C = 100 µAdc, I _E = 0)	V(BR)CBO	45		17	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	6.5		ΙŻ	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	ICBO		1.0	50	nAdc
ON CHARACTERISTICS(2)			A Am	0 8 148	Je 19.
DC Current Gain ($I_C = 10 \ \mu Adc, \ V_{CE} = 5.0 \ Vdc$) ($I_C = 100 \ \mu Adc, \ V_{CE} = 5.0 \ Vdc$) ($I_C = 1.0 \ m Adc, \ V_{CE} = 5.0 \ Vdc$) ($I_C = 10 \ m Adc, \ V_{CE} = 5.0 \ Vdc$)	hFE	400 500 500 500	580 850 1100 1150	— — — — 1500	1
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)	VCE(sat)	(14) V	0.08	0.2 0.3	Vdc
Base-Emitter On Voltage (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	V _{BE(on)}	_	0.6	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (IC = 1.0 mAdc, VCE = 5.0 Vdc, f = 100 MHz)	ft T	100	160	RUD <u>H</u> Fillust I	MHz
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{cb}		1.7	3.0	pF
Emitter-Base Capacitance (V _{EB} = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	C _{eb}	3.0	5.6	6.5	pF
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 k Ω , f = 10 Hz to 15.7 kH (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 1.0 k Ω , f = 100 Hz)	NF	0.5	0.5 4.0	1.5	dB
Equivalent Short Circuit Noise Voltage (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 1.0 k Ω , f = 100 Hz)	VT	101	6.5		nV/√H

FIGURE 1 - TRANSISTOR VOISE MODEL

(1) R_{ØJA} is measured with the device soldered into a typical printed circuit board.
(2) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

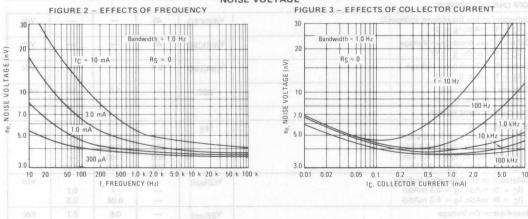
FIGURE 1 - TRANSISTOR NOISE MODEL

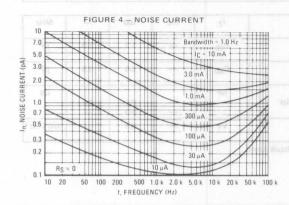


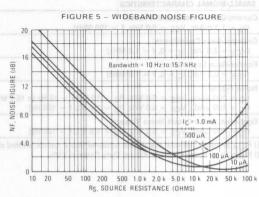
NOISE CHARACTERISTICS

(V_{CE} = 5.0 Vdc, T_A = 25°C)

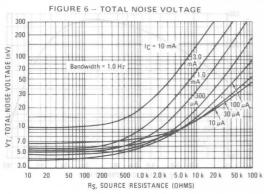
NOISE VOLTAGE







ATAC 3210N zH 001 URE 12 - CURRENT-GAIN-BANDWIDTH



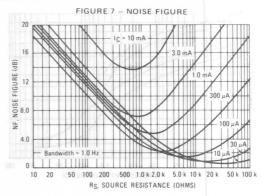


FIGURE 8 — DC CURRENT GAIN

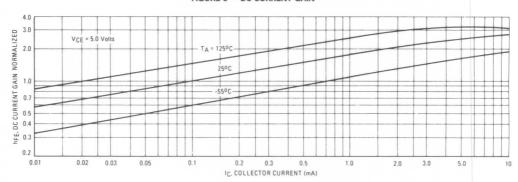


FIGURE 9 - "ON" VOLTAGES

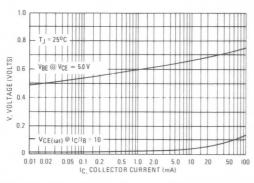
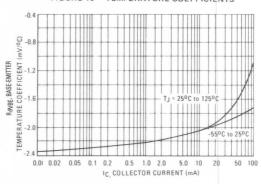
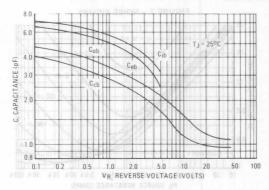


FIGURE 10 - TEMPERATURE COEFFICIENTS

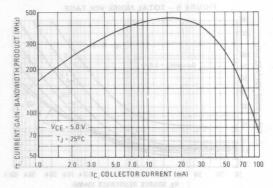


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 11 - CAPACITANCE



ATAO 3210M SH FIGURE 12 - CURRENT-GAIN-BANDWIDTH PRODUCT



QURE 8 -- DC QUERENT GAR

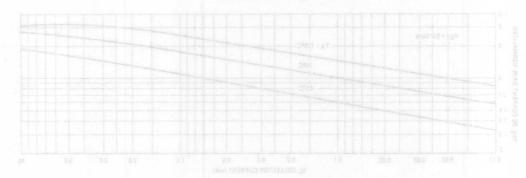


FIGURE 10 - TEMPERATURE COEFFICIENTS

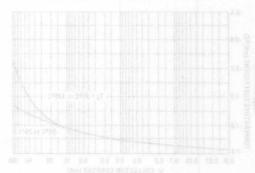
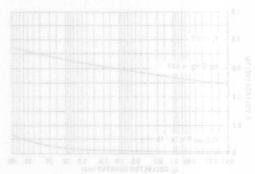


FIGURE 9 - "ON" VOLTACES



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

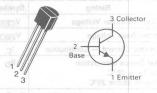
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	4.0	Vdc
Collector Current — Continuous	IC O	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	P _D	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD W	1.5	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C - 56 to +

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R ₀ JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

MPSA20

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPS3903 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Yin Char	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	1-2-1-2			1	POLICEMENTON	AND THE
Collector-Emitter Breakdown Voltage(2) (I _C = 1.0 mAdc, I _B = 0)	V(BR)CES	MPSA25	V(BR)CEO		mitta <u>r Brentel</u> 0 "Ado, Vag	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)		MPSA27	V(BR)EBO	4.0	_	Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0)	Овлине	MPSA25 MPSA26	ICBO	- 66aunn (0	100	nAdc
ON CHARACTERISTICS		MPSA27				
DC Current Gain(2) (I _C = 5.0 mAdc, V _{CE} = 10 Vdc)	leso	MRSA25	hFE	40	9 = 9 V 08) non (44 6) = 83¥1
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		MPSAZ6 MPSAZ7	V _{CE(sat)}	_	0.25	Vdc
SMALL-SIGNAL CHARACTERISTICS	SEO	204204			THE THUS THOSE	roraniri s
Current-Gain — Bandwidth Product(2) (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 1	00 MHz	MPSA26 MPSA27	fT	125 (0	+ 30 V. V 04 + 30 V. V 06 + 30 V. V 06	MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 100 kHz)	089		C _{obo}	_	4.0	pF

(1) R_{ØJA} is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%.

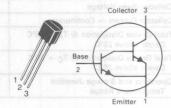
Rating	Symbol	MPS-A25	MPS-A26	MPS-A27	Unit
Collector-Emitter Voltage	VCES	40	50	60	Vdc
Emitter-Base Voltage	VEBO		10	625	Vdc
Collector Current — Continuous	lc	1 3	500	0.8	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	2	625 5.0	1.5 12 8 to + 160	mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-	55 to +1	50	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	R ₀ JA	200	°C/W

MPSA27

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



DARLINGTON TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

rinti zelej Char	acteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					nes	BIRSTOAN	AHD 990
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)	030(88) ^V	MPSA25 MPSA26	V(BR)CES	40 50	_	0 mAde, 1	Vdc = ol)
5DV - 9.8	O83(86)V	MPSA27		60	ISBOY MYU	aso <u>Br</u> ealm	E nettime
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)		MPSA25 MPSA26 MPSA27	V(BR)CBO	40 50 60	- 808 - 07 - 08	Out <u>off</u> Our 10 Vets It	Vdc
Collector Cutoff Current (VCB = 30 V, IE = 0) (VCB = 40 V, IE = 0) (VCB = 50 V, IE = 0)	Sad VCE(sat)	MPSA25 MPSA26 MPSA27	ІСВО		CE = 10 V	100 100 100	nAdc
Collector Cutoff Current (V _{CE} = 30 V, V _{BE} = 0) (V _{CE} = 40 V, V _{BE} = 0) (V _{CE} = 50 V, V _{BE} = 0)	n	MPSA25 MPSA26 MPSA27	ICES	(E) touti	ARACTERIS dwidth Pro CE — 10 V	500 500 500	
Emitter Cutoff Current (VBE = 10 Vdc)	odo [©]		IEBO	(s)+61.00	= 0, f ==	epri100 squ dipbV 01	nAdc 80V)
ON CHARACTERISTICS(1)		lated direct board.		neblos esive	with the de	measured	S ALMER
DC Current Gain (I _C = 10 mA, V_{CE} = 5.0 V) (I _C = 100 mA, V_{CE} = 5.0 V)			hFE	10,000 10,000	OS A PIENV	E PUISG	981 <u>174</u> 1
Collector-Emitter Saturation Voltage ($I_C = 100$ mA, $I_B = 0.1$ mAdc)			VCE(sat)	-	-	1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mA, V _{CE} = 5.0 Vdc)			V _{BE(on)}	-	-	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS							
Small Signal Current Gain (IC = 10 mA, VCF = 5.0 V, f = 100) MHz)		h _{fe}	1.25	2.4	_	-

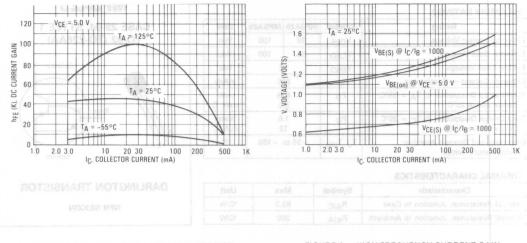
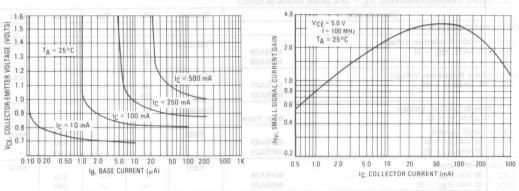
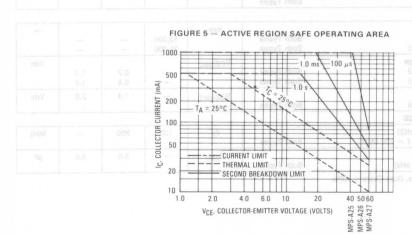


FIGURE 3 — COLLECTOR SATURATION REGION

FIGURE 4 - HIGH FREQUENCY CURRENT GAIN





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

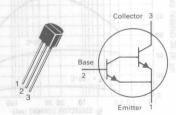
MAXIMUM RATINGS				INSUS SEC
Rating	Symbol	MPSA28	MPSA29	Unit
Collector-Emitter Voltage	VCES	80	100	Vdc
Collector-Base Voltage	Vсво	80	100	Vdc
Emitter-Base Voltage	VEBO	1	2	Vdc
Collector Current — Continuous	Ic	5	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 to	0 +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W	
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W	

MPSA28 MPSA29

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



DARLINGTON TRANSISTOR

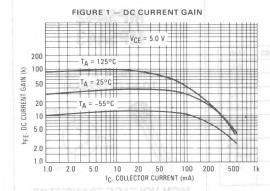
NPN SILICON

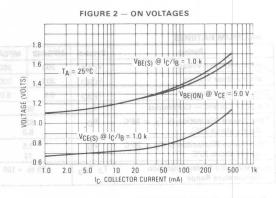
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

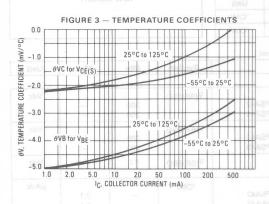
Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	191					1.5
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)	MPSA28 MPSA29	V(BR)CES	80 100	Ξ	A - 25°C	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	MPSA28 MPSA29	V(BR)CBO	80 100			Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	Both Types	V(BR)EBO	12		+	Vdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 80 Vdc, I _E = 0)	MPSA28 MPSA29	СВО			100 100	nAdc
Collector Cutoff Current (V _{CE} = 60 Vdc, V _{BE} = 0) (V _{CE} = 80 Vdc, V _{BE} = 0)	MPSA28 MPSA29	ICES	(Asj Trian)	Ig. BASE CU	500 500	nAdc
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)	Both Types	IEBO	_	-	100	nAdc
ON CHARACTERISTICS(1)						
DC Current Gain (I _C = 10 mAdc, V _{CE} = 5.0 Vdc) (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)	Both Types Both Types	HE SHACE	10,000	_	_	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.01 mAdc) (I _C = 100 mAdc, I _B = 0.1 mAdc)	Both Types Both Types	VCE(sat)	000	0.7 0.8	1.2 1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)	Both Types	V _{BE(on)}	200	1.4	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS			- 601 E			
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	Both Types	fT	125	200	_	MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 100 kHz)	Both Types	C _{obo}	-8	5.0	8.0	pF

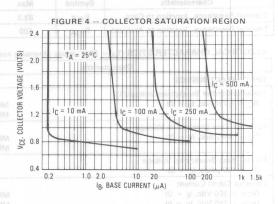
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

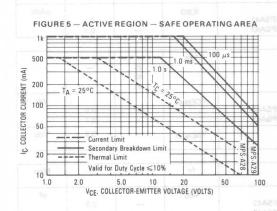
(2) $f_T = h_{fe} \cdot f_{test}$.

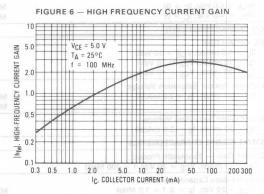












Rating	Symbol	MPSA42	MPSA43	Unit
Collector-Emitter Voltage	VCEO	300	200	Vdc
Collector-Base Voltage	VCBO	300	200	Vdc
Emitter-Base Voltage	VEBO	6.0	6.0	Vdc
Collector Current — Continuous	1c	5	00	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		.0 .0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _B JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPSA42 MPSA43

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

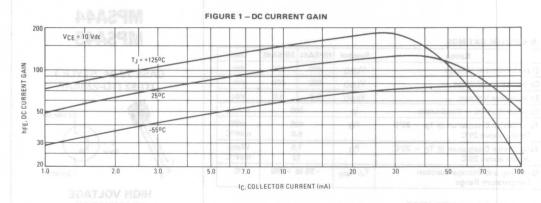


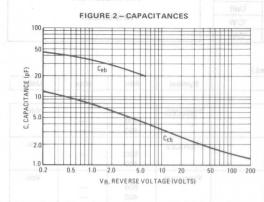
HIGH VOLTAGE TRANSISTOR

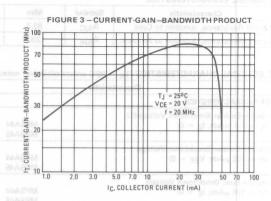
NPN SILICON

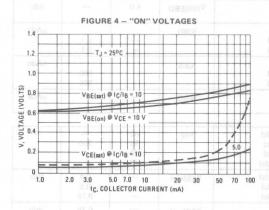
EL	ECTRICAL	CHARACTERISTICS	(TA	-	25°C unless	otherwise	noted.)
EL	ECINICAL	CHARACTERISTICS	LIA		25 C unless	otherwise	notea.

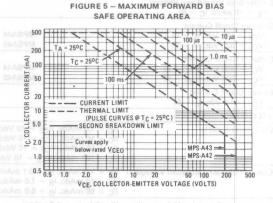
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	2500	er gena-			105
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	MPSA42 MPSA43	V(BR)CEO	300 200		Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	MPSA42 MPSA43	V(BR)CBO	300 200	-Valle	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)	[[]]]	V(BR)EBO	6.0	77 T- Name of St. O. S.	Vdc
Collector Cutoff Current (VCB = 200 Vdc, $I_E = 0$) (VCB = 160 Vdc, $I_E = 0$)	MPSA42 MPSA43	СВО	NUECTOR CUBRI	0.1 0.1	μAdc
Emitter Cutoff Current (VBE = 6.0 Vdc, IC = 0) (VBE = 4.0 Vdc, IC = 0)	MPSA42 MPSA43	DBO TARE OPERAT	8 E GI <u>O</u> ID 3 8	3VIT0.1 - 3	μAdc
ON CHARACTERISTICS(1)		ELAT			
DC Current Gain (IC = 1.0 mAdc, V _{CE} = 10 Vdc) (IC = 10 mAdc, V _{CE} = 10 Vdc) (IC = 30 mAdc, V _{CE} = 10 Vdc)	Meni cylu	hFE	25 40 40		200 200
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	MPSA42 MPSA43	VCE(sat)		0.5 0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		V _{BE} (sat)	Both State of State o	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS			Teru	J-Inminet Tales	2.0
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	E 1814-11	fT	50	2.0	MHz
Collector-Base Capacitance (VCB = 20 Vdc, I _E = 0, f = 1.0 MHz)	MPSA42 MPSA43	C _{cb}	RETTIMS ROTO:	3.0 4.0	pF











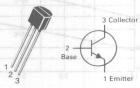
Rating	Symbol	MPSA44	MPSA45	Unit
Collector-Emitter Voltage	VCEO	400	350	Vdc
Collector-Base Voltage	VCBO	500	400	Vdc
Emitter-Base Voltage	VEBO	6.0	6.0	Vdc
Collector Current — Continuous	lc -	300		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		O °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPSA45

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					宇宙中 音
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	MPSA44 MPSA45	V(BR)CEO	400 350		Vdc
Collector-Emitter Breakdown Voltage (IC = 100 μ Adc, V _{BE} = 0)	MPSA44 MPSA45	V(BR)CES	500 400		Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)		V(BR)CBO	500 400	- N	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)			6.0	RIGHTS) T	Vdc
Collector Cutoff Current (V _{CB} = 400 Vdc, I _E = 0) (V _{CB} = 320 Vdc, I _E = 0)	MPSA44 MPSA45	Ісво		0.1	μAdc
Collector Cutoff Current (VCE = 400 Vdc, VBE = 0) (VCE = 320 Vdc, VBE = 0)	MPSA44 MPSA45	ICES		500 500	nAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	TOTAL TOTAL	IEBO	1 0 <u>1 8/3</u>	0.1	μAdc
ON CHARACTERISTICS(1)	JAMHANT		V dl = 38V	9 (so)287	1 1 10
(I ₁	The Cartie of th		40 50 45 40	200	5.0
	C = 1.0 mAdc, I _B = 0.1 mAdc) C = 10 mAdc, I _B = 1.0 mAdc) C = 50 mAdc, I _B = 5.0 mAdc)	VCE(sat)	DI 7.5 (RAUO NO 133.	0.4 0.5 0.75	Vdc
Base-Emitter Saturation Voltage (I _C = 10	mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}	L	0.75	Vdc
SMALL-SIGNAL CHARACTERISTICS		ATE IN LESS	THE HALL		
Output Capacitance (V _{CB} = 20 Vdc, I _E =	Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MHz)			7.0	pF
Input Capacitance (V _{EB} = 0.5 Vdc, I _C =	0, f = 1.0 MHz)	Cibo	_	13	pF
Small-Signal Current Gain (IC = 10 mAd	c, V _{CE} = 10 Vdc, f = 10 MHz)	hfe	2.0		-

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

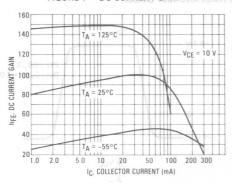


FIGURE 1 — DC CURRENT GAIN ON A SEMIT BRINDTING FIGURE 2 — COLLECTOR SATURATION REGION

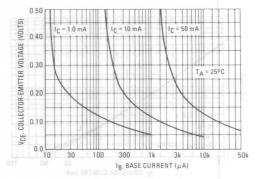


FIGURE 3 - ON VOLTAGES

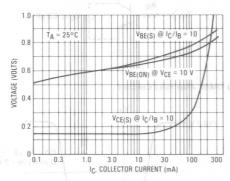


FIGURE 4 - ACTIVE REGION - SAFE OPERATING AREA

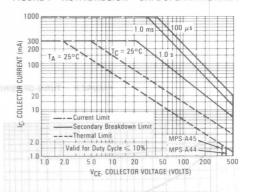


FIGURE 5 — CAPACITANCE

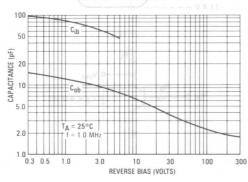
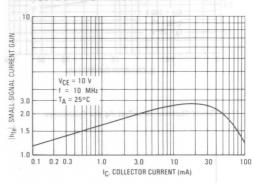
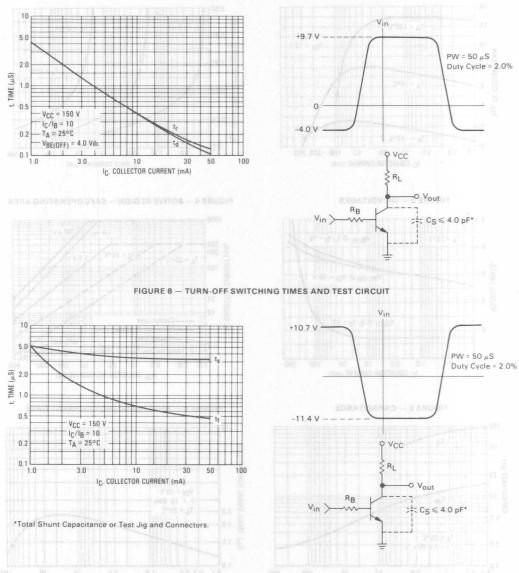


FIGURE 6 - HIGH FREQUENCY CURRENT GAIN



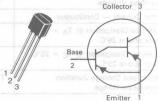
MODERAR MODERARD AS FIGURE 7 — TURN-ON SWITCHING TIMES AND TEST CIRCUIT



MAXIMUM RATINGS MPSA62 MPSA63 Symbol MPSA64 Unit Rating Collector-Emitter Voltage 20 30 Vdc VCES Collector-Base Voltage **VCBO** 20 30 Vdc Emitter-Base Voltage 50V 10 Vdc **VEBO** Collector Current — Continuous 500 mAdc lc Total Device Dissipation @ TA = 25°C P_{D} 625 mW 3 W 5.0 Derate above 25°C mW/°C Total Device Dissipation @ T_C = 25°C PD ameV1.5 Watts Derate above 25°C 3 W 12 mW/°C Operating and Storage Junction -55 to +150 °C T_J, T_{stg} Temperature Range

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

MPSA64



THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	E C/W

DARLINGTON TRANSISTOR

PNP SILICON

Refer to MPSA75 for graphs.

zinti xaivi aivi Cha	racteristic		Symbol	Min Cir	Max	Unit
OFF CHARACTERISTICS					CTERISTICS	MEAN F
Collector-Emitter Breakdown Voltage ($I_C = 100 \mu Adc, V_{BE} = 0$)	V(BR)CEO	MPSA62 MPSA63, MPSA64	V(BR)CES	20 30	mer Breakdo Ado, ig = 0	Vdc
Collector Cutoff Current	Урытер /	Till Griddy Hill Gridd	ICBO	matin	Emaghorada S	nAdc
(V _{CB} = 15 Vdc, I _E = 0) (V _{CB} = 30 Vdc, I _E = 0)		MPSA62 MPSA63, MPSA64	ICBO	=	100 100	null in deals
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)			IEBO		100	nAdc
ON CHARACTERISTICS(1)	田神門			Leda M. Diff.	Sam o Arto Most o	a distribution
DC Current Gain (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	VCE(sot)	MPSA63 MPSA64 MPSA62	hFE		itter Saturation Ado, ig = 1.	mB-rethell
$(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		MPSA63 MPSA64	100 MHz)	10,000 20,000	- Bandwidt - Adc. #GE =	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 0.01 \text{ mAdc}$) ($I_C = 100 \text{ mAdc}$, $I_B = 0.1 \text{ mAdc}$)	000	MPSA62 MPSA63, MPSA64	VCE(sat)	sHot 001 = 1	0 = al abV 1.0 1.5	Vdc
Base-Emitter On Voltage (I _C = 10 mAdc, V_{CE} = 5.0 Vdc) (I _C = 100 mAdc, V_{CE} = 5.0 Vdc)		MPSA62 MPSA63, MPSA64	V _{BE(on)}	_	1.4 2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(2) (I _C = 100 mAdc, V _{CF} = 5.0 Vdc, f =	100 MHz)	MPSA63, MPSA64	f _T	125	-	MHz

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ $f_T = |h_{fe}| \cdot f_{test}$

MAXIMUM RATINGS					
Rating	Symbol	Value **	Unit		
Collector-Emitter Voltage	VCEO	35V 40 0E	Vdc		
Emitter-Base Voltage	VEBO	abV 4.0	○ Vdc		
Collector Current — Continuous	IC	abAm100	mAdc		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.00 1.5 2.00 12	Watts mW/°C		
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C		

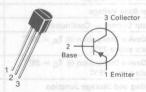
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	s s°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	W 83.3	°C/W

MPSA70 A MURRICAN

See MPS MS, MPSAGE Date

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

FLECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted)

	xxiiii niiii c	haracteristic		Symbol	Min	Max	Unit
OFF CHARAC	CTERISTICS					aomaine n	OFF CHAFAC
	itter Breakdown Voltage nAdc, I _B = 0)	V(BR)CES	MESABS	V(BR)CEO	40	eran B ra dkdow Adc. Vage = 0	Vdc
	Breakdown Voltage µAdc, I _C = 0)	OBOL	MISASS, MISASK	V(BR)EBO	4.0	off Current	Vdc
Collector Cut (V _{CB} = 30	off Current Vdc, IE = 0)		MPSA63, MPSA64	ІСВО	-	100	nAdc
ON CHARAC	CTERISTICS	083/				COPPLETE	TOTAL TRAINER
DC Current G	Gain nAdc, V _{CE} = 10 Vdc)			hFE	40	400	DARARO MO
	itter Saturation Voltage nAdc, I _B = 1.0 mAdc)	390	MPSA62	VCE(sat)	(5 bV d	0.25	Vdc
SMALL-SIGN	NAL CHARACTERISTICS		MPSA62				
	— Bandwidth Product nAdc, V _{CE} = 10 Vdc, f	= 100 MHz)	MPSA63	fΤ	125 (867 0.8	nAde. Veg =	MHz (3) = 3)
Output Capa (V _{CB} = 10	citance Vdc, I _E = 0, f = 100 kH	lz) (nse)30V	(10.01.00) 1191 (10.01.00) 1191	C _{obo}		4.0	
			MPSASS, MPSA64			Ado; lg = 0.5 nAdo, lg = 0.7	

ROURE 1 - DC CURRENT GAIN

MAXIMUM RATINGS

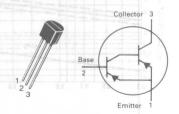
Rating	Symbol	MPSA75	MPSA77	Unit
Collector-Emitter Voltage	VCES	40	60	Vdc
Emitter-Base Voltage	VEBO	1	0	Vdc
Collector Current — Continuous	Ic	5	00	Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		25	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	√-55 to	+ 150	o°C

THERMAL CHARACTERISTICS TO BUILDING TO BE BRUDEN

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	200	°C/W

MPSA75 MPSA77

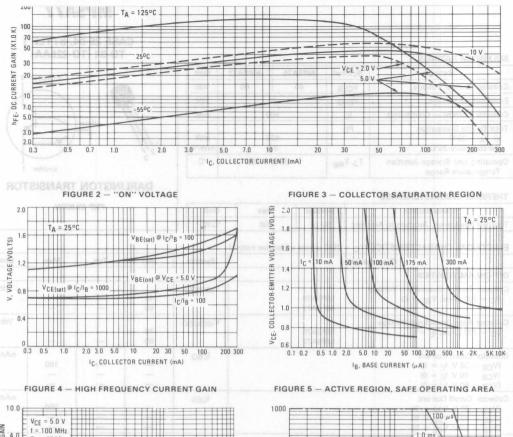
CASE 29-04, STYLE 1 TO-92 (TO-226AA)



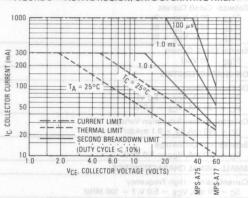
DARLINGTON TRANSISTOR

PNP SILICON

Am 687 Am av / Characteristic	Am III - pl	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	A United Fire to		Vine il Vine			3
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)	MPSA75 MPSA77	V(BR)CES	40 60	1 000 r g/\	1.0 (rec)30 V	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	MPSA75 MPSA77	V(BR)CBO	40 60			Vdc
Collector Cutoff Current (V _{CB} = 30 V, I _E = 0) (V _{CB} = 40 V, I _E = 0) (V _{CB} = 50 V, I _E = 0)	1 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.	ICBO (A	OF CHARRY (IN	10 3.9 5.0 S	100	nAdc
Collector Cutoff Current (V _{CE} = 30 V, V _{BE} = 0) (V _{CE} = 40 V, V _{BE} = 0) (V _{CE} = 50 V, V _{BE} = 0)	0001	ICES			500 V =	nAdc
Emitter Cutoff Current (VBE = 10 Vdc)	007 5	IEBO	17	1	100	nAdc
ON CHARACTERISTICS			All		N. I	
DC Current Gain (I _C = 10 mA, V _{CE} = 5.0 V) (I _C = 100 mA, V _{CE} = 5.0 V)	\$ 100 E	hFE	10,000 10,000			
Collector-Emitter Saturation Voltage (I _C = 100 mA, I _B = 0.1 mAdc)		VCE(sat)			1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mA, V _{CE} = 5.0 Vdc)	10)	V _{BE}			2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	2	NY 000 005		DZ DZ	D.6 9.3	\$1.1
Current-Gain — High Frequency (I _C = 10 mA, V _{CE} = 5.0 V, f = 100 MHz)		h _{fe}	1.25	2.4	_	_



IC. COLLECTOR CURRENT (mA)



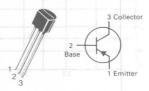
Rating	Symbol	MPSA92	MPSA93	Unit
Collector-Emitter Voltage	VCEO	300	200	Vdc
Collector-Base Voltage	Vсво	300	200	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	500		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}		+ 150	°C

THERMAL CHARACTERISTICS

TOUGO Characteristic MIAD TABLE	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPSA93

CASE 29-04, STYLE 1 TO-92 (TO-226AA)

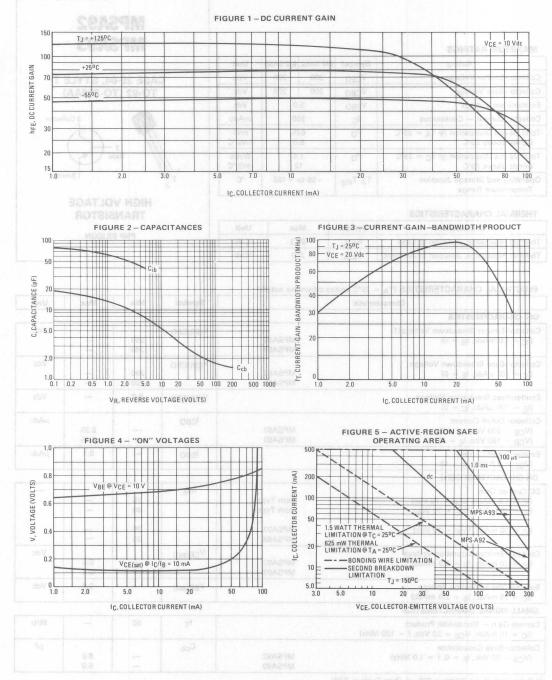


HIGH VOLTAGE TRANSISTOR

PNP SILICON

Characteristic	3 191	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	E HHHE				
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	MPSA92 MPSA93	V(BR)CEO	300 200		Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	MPSA92 MPSA93	V(BR)CBO	300 200		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)		V(BR)EBO	5.0	ē —	Vdc
Collector Cutoff Current (VCB = 200 Vdc, IE = 0) BARASVITOA - 8 ARUDIA (VCB = 160 Vdc, IE = 0) BARA DMITARAGO	MPSA92 MPSA93	ICBO	V "W S" — P	0.25 0.25	μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)		IEBO		0.1	μAdc
ON CHARACTERISTICS(1)					
DC Current Gain (IC = 1.0 mAdc, V _{CE} = 10 Vdc) (IC = 10 mAdc, V _{CE} = 10 Vdc)	Both Types Both Types	hFE	25 40	9 39 /	-
(I _C = 30 mAdc, V _{CE} = 10 Vdc)	MPSA92 MPSA93		25 25	+=+	
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	MPSA92 MPSA93	VCE(sat)	101 9 10182V	0.5 0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		VBE(sat)	PT 0.8	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS		(Am) THERM	COULTECADY CO		
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)		fT	50	_	MHz
Collector-Base Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MHz)	MPSA92 MPSA93	C _{cb}	=	6.0 8.0	pF

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.



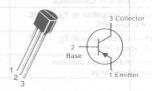
MAXIMONI NATINGS			
Rating Date 30AD	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	aby 25	Vdc
Collector-Base Voltage	VCBO	25	Vdc
Collector Current — Continuous	IC	600	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient(1)	$R_{\theta JA}$	200	oo °C/W

MPSD55

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N4400 for MPSD05 graphs.*

Not KAM BYT C	haracte	ristic and a	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					BONTENERTON	RANG T
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	09	OBO(RB)VEO	V(BR)CEO	25	alter Brackdo raAde, Ig. = 0	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	08	Vericeo	V(BR)CBO	25	se Bra skdown AACc Ig = 0	Vdc
Collector Cutoff Current (V _{CE} = 20 Vdc)	0.8	OBB(AB)V	ICEO	Totager	Bres0.foven	μAdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)		0801	СВО	_	of Co.tent	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0)			IEBO	_	1100	nAdc
ON CHARACTERISTICS(2)					cyamarics	ABRAOL
DC Current Gain ($I_C = 50 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 100 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 500 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$)	30	344	hFE	50 80 30	Gein mAdo <u>v</u> os =	inema o
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)		(36823-37	V _{CE} (sat)	(StrAm C	0.5	Vdc
SMALL-SIGNAL CHARACTERISTICS	no.			to denot	Walter State of State	
Current-Gain — Bandwidth Product (I f = 100 MHz)	C = 50	mAdc, V _{CE} = 10 Vdc,	influi con	100	= 30 = obAss	MHz

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{*}Refer to 2N4402 for MPSD55 graphs.

MAXIMI IM BATINGS

MAXIMUM RATINGS		Talada .	enteller ve
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	80	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	Ic	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ $T_C = 25^{\circ}C$ Derate above 25°C	PD	1.5	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

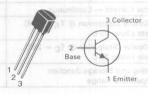
THERMAL CHARACTERISTICS

Characteristic Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

MPSH04

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



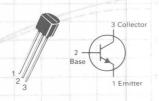
AMPLIFIER TRANSISTOR

NPN SILICON

Charac	teristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					81	ACTEMBETIC	PARO TI
Collector-Emitter Breakdown Voltage(2 $(I_C = 1.0 \text{ mAdc}, I_B = 0)$	VIBRICEO (V(BR)CEO	80	dow <u>n</u> Volki = 0)	lsee S <u>r</u> emin Ligit JouAnn	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)			V _(BR) CBO	80	eyn <u>Vo</u> ttage (t)	sse <u>re</u> akti "Ado, ig m	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	030)		V _{(BR)EBO}	4.0	- 1	noff Current Vdel	Vdc
Collector Cutoff Current (VCB = 60 Vdc, I _E = 0)	0831		ICBO	-	(0)	50	nAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)	ceat		IEBO	-	(0 -	50	nAdc
ON CHARACTERISTICS	المحاسب السعاديات				8(2)	OTTHERTO	N CHAIL
DC Current Gain (I _C = 1.5 mAdc, V _{CE} = 10 Vdc)	337		hFE	30	56V <u>0.8</u> = 50 Vdc	120	C <u>Le</u> ment (IC = 50 IC = 10
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	(tes)30V		V _{CE} (sat)	81	estipy moise	0.25	Vdc
SMALL-SIGNAL CHARACTERISTICS					(SEARTE U)	St. marin t	-1 - 017
Crrent-Gain — Bandwidth Product (I _C = 1.5 mAdc, V _{CE} = 10 Vdc, f =	100 MHz)	10 Vdc.	= 30V 26Am	80 08 = 50	AUTORISTA Vidth Produc		MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, f = 1.0 MHz)		brand tipstis beard.	C _{cb}	perablos s	diveb and di	1.6	pF at ALM
Output Admittance (I _C = 1.5 mAdc, V _{CE} = 10 Vdc, f =	1.0 kHz)		h _{oe}	igi Alad Alad S	SDSS graph	5.0	μmhos
Noise Figure (IC = 1.5 mAdc, VCE = 10 Vdc, RS	= 50 ohms f :	= 1.0 MHz) MPSH04	NF	-		2.0	dB

MPSH07

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



FM/VHF TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.81	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _O JC	T= 357 A9	°C/W

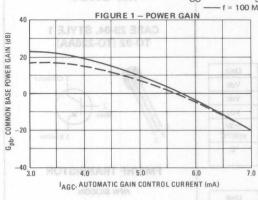
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) M. OOT = 1.

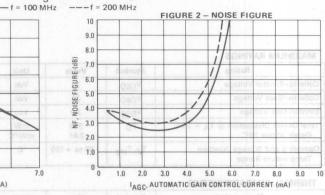
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	- Harrier - Street		o tringin	
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	30	_	Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	V _(BR) CBO	30		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	V _{(BR)EBO}	3.0	- 6.2	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)	ICBO		50	nAdc
ON CHARACTERISTICS			and the same	
DC Current Gain (IC = 3.0 mAdc, VCE = 10 Vdc)	hFE	20	_	13
Base-Emitter On Voltage (I _C = 3.0 mAdc, V _{CE} = 10 Vdc)	V _{BE(on)}		0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS 0.0 0.5 0.1 0 0 0.5	6,0 7.0 8.0 9.0		2.0 3.0	nd m
Current-Gain — Bandwidth Product (I _C = 3.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	(fT) TWEE	400	10° c)	MHz
Collector-Emitter Capacitance ($V_{CE} = 10 \text{ Vdc}, I_B = 0, f = 1.0 \text{ MHz}, \text{ base guarded}$)	C _{ce} (C _{rb})	-	0.3	pF
Noise Figure ($I_C = 3.0 \text{ mAdc}$, $V_{CB} = 10 \text{ Vdc}$, $R_S = 50 \text{ Ohms}$, $f = 100 \text{ MHz}$)	NF NF	ART <u>CIR</u> AN	3.0	dB
FUNCTIONAL TEST				7-10
Common-Emitter Amplifier Power Gain (IC = 3.0 mAdc , VCB = 10 Vdc , RS = 50 Ohms , f = 100 MHz) (IC = 3.0 mAdc , VCB = 10 Vdc , RS = 50 Ohms , f = 200 MHz)	G _{pb}	18 14	1-0	dB
Forward AGC Current (Gain Reduction = 30 dB, R _S = 50 Ohms, f = 100 MHz)	IAGC	6.5	8.5	mAdc
10 ⁰ 8.1 9.5		erië .		
				F

2



 V_{CC} = 10 Vdc, R_S = 50 Ohms, See Figure 9



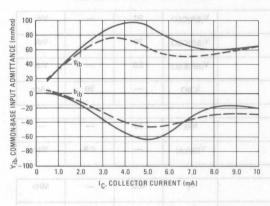


COMMON-BASE y PARAMETERS

V_{CB}= 10 Vdc, T_A = 25^oC

FIGURE 3 - INPUT ADMITTANCE

FIGURE 4 - REVERSE TRANSFER ADMITTANCE



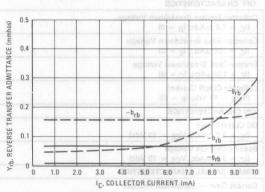
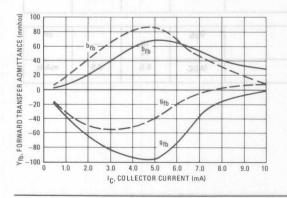
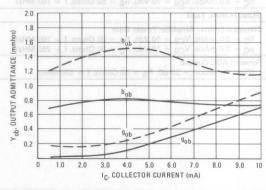


FIGURE 5 - FORWARD TRANSFER ADMITTANCE

FIGURE 6 - OUTPUT ADMITTANCE





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 7 - COLLECTOR-BASE TIME CONSTANT

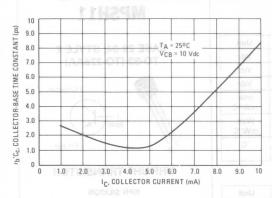


FIGURE 8 - CURRENT-GAIN BANDWIDTH PRODUCT

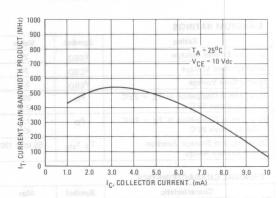
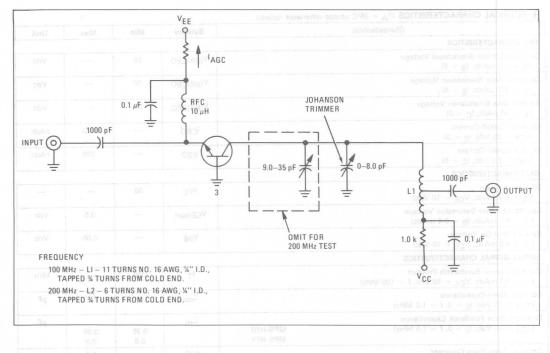
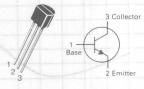


FIGURE 9 - 100-MHz AND 200-MHz COMMON-BASE AMPLIFIER



		20.00	22.2
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	Vсво	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	350 2.8	mW/°C
Total Device Dissipation $(a T_C = 25^{\circ}C)$ Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	357	°C/W

VHF/UHF TRANSISTOR

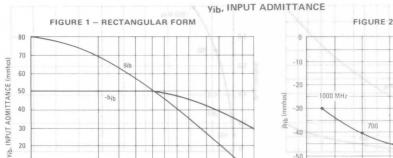
NPN SILICON

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	1.5			
Collector-Emitter Breakdown Voltage ($I_C = 1.0 \text{ mAdc}$, $I_B = 0$)	V(BR)CEO	25		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc$, $I_E = 0$),	V(BR)CBO	30		Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	3.0		Vdc
Collector Cutoff Current (V _{CB} = 25 Vdc, I _E = 0)	Ісво		Tg 0(100	nAdc
Emitter Cutoff Current (V _{BE} = 2.0 Vdc, I _C = 0)	IEBO	-	100	nAdc
ON CHARACTERISTICS				
DC Current Gain (IC = 4.0 mAdc, VCE = 10 Vdc)	hFE	60		_
Collector-Emitter Saturation Voltage (I _C = 4.0 mAdc, I _B = 0.4 mAdc)	VCE(sat)	1	0.5	Vdc
Base-Emitter On Voltage (IC = 4.0 mAdc, VCE = 10 Vdc)	V _{BE}	-	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS				CHESINA
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT (3H)	650	SNULL DATE	MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$)	C _{cb}	FRO W COLO	аиву 0.7	pF
Common-Base Feedback Capacitance	C _{rb}			pF
CB	PS-H10 PS-H11	0.35 0.6	0.65 0.9	
Collector Base Time Constant (I _C = 4.0 mAdc, V _{CB} = 10 Vdc, f = 31.8 MHz)	rb′C _C	-	9.0	ps

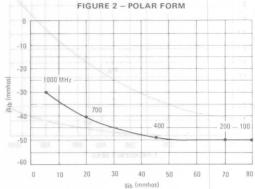
10

COMMON-BASE y PARAMETERS versus FREQUENCY

MRO3 RAJOS - 8 SAUDI (VCB = 10 Vdc, IC = 4.0 mAdc, TA = 25°C)



f, FREQUENCY (MHz)

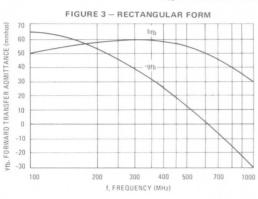


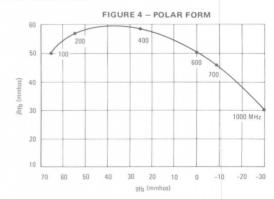
COMMON-BASE y PARAMETERS versus FREQUENCY

700

 $(V_{CB} = 10 \text{ Vdc}, I_{C} = 4.0 \text{ mAdc}, T_{A} = 25^{\circ}\text{C})$

yfb, FORWARD TRANSFER ADMITTANCE





yrb, REVERSE TRANSFER ADMITTANCE

FIGURE 5 – RECTANGULAR FORM

1.0

200

300

400

500

700

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

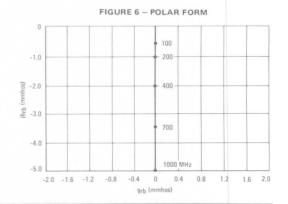
1000

1000

1000

1000

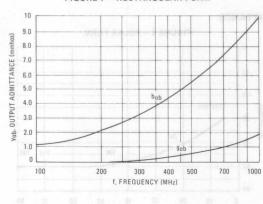
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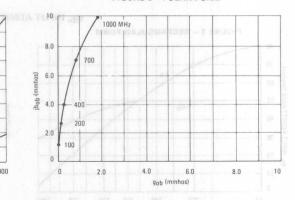


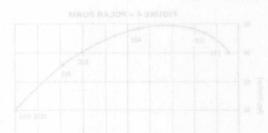
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

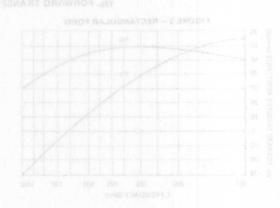
Yob, OUTPUT ADMITTANCE

FIGURE 7 – RECTANGULAR FORM

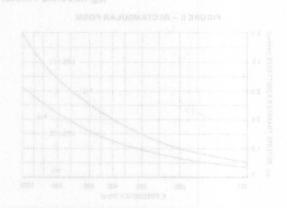












MPSH20

MAXIMUM RATINGS

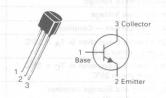
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	pAm 15 0	Vdc
Collector-Base Voltage	V _{CBO}	Am 20 0	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Total Device Dissipation (α T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	en eg .C =

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (Printed Circuit Board Mounting)	$R_{\theta JA}$	200	°C/W

MPSH17

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



CATV TRANSISTOR

NPN SILICON

tinU xaM gy7 Characteristic odgm2	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			rics	SIRS TO A F	AHO FEO
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	15	ekdu ni n Ve i = (i)	es es ime O rupde, is	Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	V(BR)CBO	20 🧝	ssloV -n ecets (0 =	Sise r B reak 30 Juneo. B	Vdc
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$	V(BR)EBO	3.0	owe yo nag = 0)	njes ta ele al abéa	Vdc
Collector Cutoff Current — (VCB = 15 Vdc, IE = 0)	ІСВО	_	- five	100	nAdc
ON CHARACTERISTICS			230	retes to a	ON UND
DC Current Gain (IC = 5.0 mAdc, VCE = 10 Vdc)	hFE	25	V-07 = 20	250	NO
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	VCE(sat)	-630	DIRECTION AND	0.5	Vdc
SMALL-SIGNAL CHARACTERISTICS	(xHi)	007 = 1.00	V 67 = 20	Cab/an E	
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	800	= 0. f = 1		MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, f = 1.0 MHz)	C _{cb}	0.3	Constant Constant		pF
Small-Signal Current Gain (IC = 5.0 mAdc, VCE = 10 Vdc, f = 1.0 kHz)	h _{fe}	30	HM c= or 8 V Of > an		-
Noise Figure (I _C = 5.0 mAdc, V_{CC} = 12 Vdc, R_S = 50 ohms, f = 200 MHz)	NF		labV		dB
FUNCTIONAL TEST					
Amplifier Power Gain $(I_C = 5.0 \text{ mAdc}, V_{CC} = 12 \text{ Vdc}, R_S = 50 \text{ ohms}, f = 200 \text{ MHz})$	Gpe	_	24	-	dB

Rating 85 32 45	Symbol	Value	Unit	
Collector-Emitter Voltage	VCEO	30	Vdc	
Collector-Base Voltage	Vсво	40	Vdc	
Emitter-Base Voltage	VEBO	inu 4.0 su	Vdc	
Collector Current — Continuous	IC	abV 100	mAdc	
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	350 2.81	mW/°C	
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watts mW/°C	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	or ad °C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	357	°C/W

MPSH20

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



VHF TRANSISTOR

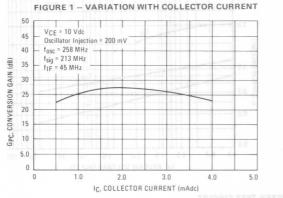
NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) who seekled 3"dS = gTI 83F8793A9AH3 JACHRT33.13

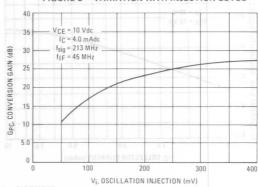
Characteristic Characteristic	Symbol Min Typ Max Unit
OFF CHARACTERISTICS	OFF CHARACTERISTICS
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO 30 gal ov n-obta v8im3 -ot Vdc (0 = gl ob Am c) = gll
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	V(BR)CBO 40 90 H03-4-v00 90 4-35 9 UVdc (0 = pt.55A-00 = pfl
Emitter-Base Breakdown Voltage 0.ε OS 3(AS V	V(BR)EBO 4.0 spatish rww objects as a teVdc (0 = gf, abAn of = gt)
Collector Cutoff Current (VCB = 15 Vdc, IE = 0)	ICBO — — — 100 CE Current — 100 CE Current — 100 CE Current — 100 CE CE CE CE CE CE CE CE CE CE CE CE CE
ON CHARACTERISTICS	ON CHARACTERSTICS
DC Current Gain (I _C = 4.0 mAdc, V _{CE} = 10 Vdc)	hFE 25 — ### 37 m m 2430 11
SMALL-SIGNAL CHARACTERISTICS (MACHE)	Collection-Emistor Saturation Vollage
Current-Gain — Bandwidth Product (IC = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	f _T 400 620 — MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	C _{cb} — 500 of 0.5 while 0.65 and 100 pF.0
Collector Base Time Constant (IE = 4.0 mAdc, V _{CB} = 10 Vdc, f = 31.8 MHz)	rb'C _c — 10 are sqs — es ² ut ps ²
Conversion Gain (213 to 45 MHz) (IC = 4.0 mAdc, VCE = 10 Vdc, Oscillator	- 18 23 0 Amai — 10 Amai —
Injection = 200 mVdc)	Notice Expense

CONVERSION GAIN CHARACTERISTICS 2 MIAD THERRUS - Y BRUSH

(TEST CIRCUIT FIGURE 9)







COMMON-EMITTER y PARAMETERS

 $(I_C = 4.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, T_A = 25^{\circ}\text{C})$



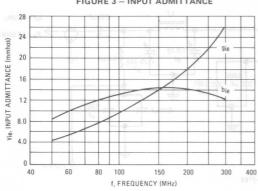
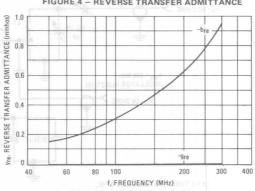


FIGURE 4 - REVERSE TRANSFER ADMITTANCE



COMMON-EMITTER y PARAMETERS

 $(I_C = 4.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, T_A = 25^{\circ}\text{C})$



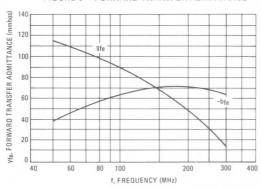
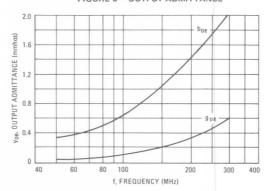
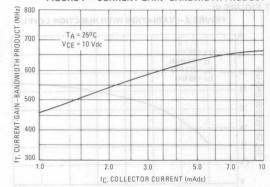


FIGURE 6 - OUTPUT ADMITTANCE



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 7 - CURRENT-GAIN-BANDWIDTH PRODUCT FIGURE 8 - CAPACITANCES



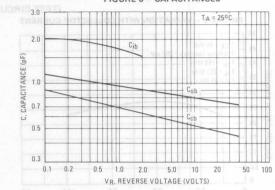
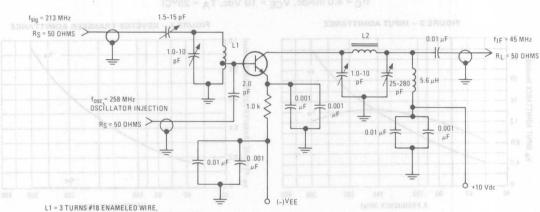
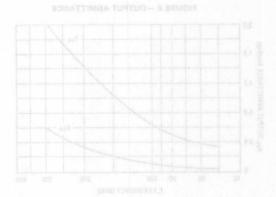


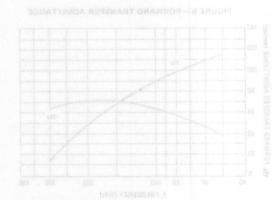
FIGURE 9 - MIXER TEST CIRCUIT



1/4" I.D., AIR WOUND, WINDING LENGTH 1/2"; BASE TAPPED 1 TURN FROM GROUND.

L2 = 10 TURNS #26 INSULATED WIRE, WOUND TEMPORARY RETTIME-MOMMOD ON 1/4" I.D. COIL FORM, ARNOLD PART C = AT JOBY OF = 30 V JOBAN O.A = 01) NO. A1-10 IRON POWDER CORE.





MPSH24

PIGURE 2. – CONVERSION GAIN PERSENTAR

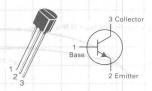
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage Mada - 2001 3 H M 3/3	VCEO	30	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	lc	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +135	°C



Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	357	°C/W

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



VHF. TRANSISTOR

NPN SILICON

Characteristic (50gs = AT 3bV 31 = a	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO	30	1 - 3 3 8 0	D17 -	Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	V _(BR) CBO	40			Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V _{(BR)EBO}	4.0	SHALETS		Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)	ІСВО	*		50	nAdc
ON CHARACTERISTICS					
DC Current Gain (IC = 8.0 mAdc, VCE = 10 Vdc)	hFE	30	No.	7	-
SMALL-SIGNAL CHARACTERISTICS				- I	
Current-Gain — Bandwidth Product (I _C = 8.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	_{sio} fT	400	620		MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$)	C _{cb}	\$1 = \$1 	0.25	0.36	pF
Conversion Gain (213 MHz to 45 MHz) ($I_C = 8.0 \text{ mAdc}$, $V_{CC} = 20 \text{ Vdc}$, Oscillator Injection = 150 mVrms) ($I_C = 8.0 \text{ mAdc}$, $V_{CC} = 20 \text{ Vdc}$, Oscillator Injection = 150 mVrms) ($I_C = 8.0 \text{ mAdc}$, $V_{CC} = 20 \text{ Vdc}$, Oscillator Injection = 150 mVrms)	ADWITTANGE	19 54 24	24 29	1 - 3 JA	dB

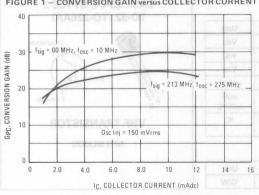
CONVERSION GAIN CHARACTERISTICS

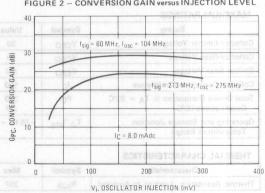
(TEST CIRCUIT FIGURE 7)

(V_{CC} = 20 Vdc, R_S = R_I = 50 Ohms, f_{if} = 44 MHz, B.W. = 6.0 MHz)



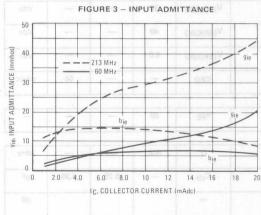
FIGURE 2 - CONVERSION GAIN versus INJECTION LEVEL

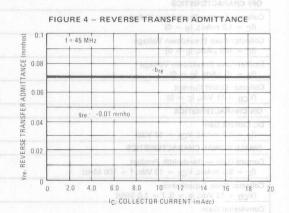


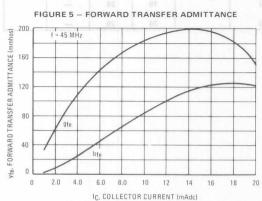


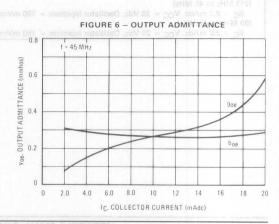
COMMON-EMITTER y PARAMETERS AT 2011318210ARANO JAOINTO 233

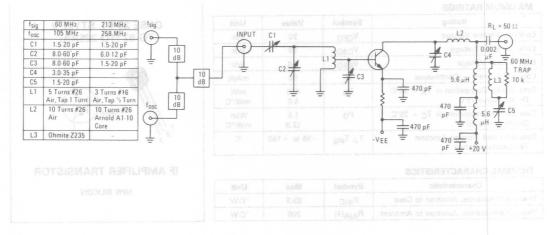
100 (VCE = 15 Vdc, TA = 25°C)











HET SARAHS TRO

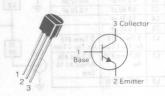
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	VCBO	20	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	IC.	50	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

MPSH30

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



IF AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			170	
Collector-Emitter Breakdown Voltage ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	V(BR)CEO	20	_	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	V(BR)CBO	20		Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)	V(BR)EBO	3.0		Vdc
Collector Cutoff Current $(V_{CB} = 10 \text{ Vdc}, I_E = 0)$	СВО	_	50	nAdo
ON CHARACTERISTICS				
DC Current Gain (I _C = 4.0 mAdc, V _{CE} = 5.0 Vdc)	hFE	20	200	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 5.0 mAdc)	VCE(sat)	0.1	3.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 5.0 mAdc)	VBE(sat)	-3	0.96	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	300	800	MHz
Collector-Base Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}, \text{ emitter guarded})$	C _{cb}	_	0.65	pF
Noise Figure $(V_{AGC} = 2.75 \text{ Vdc}, R_S = 50 \text{ ohms}, f = 45 \text{ MHz})$	NF	_	6.0	dB
FUNCTIONAL TESTS			D.H.I.	
Power Gain $(V_{AGC} = 2.75 \text{ Vdc}, R_S = 50 \text{ ohms}, f = 45 \text{ MHz})$	G _{pe}	22.5	31	dB
Forward AGC Voltage (Gain Reduction = 30 dB, R _S = 50 ohms, f = 45 MHz)	VAGC	4.4	5.4	Vdc

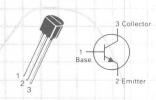
FIGURE 7 - VHP MIXEN YEST CIRCUIT.

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

AGC CHANACTERISTICS VCC = 12 Vdc, 8g = 50 Ohms, f = 45 MHz, See Figure 10

MPSH32

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



VHF TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

MAXIMOM NATINGO			- f f
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +135	°C

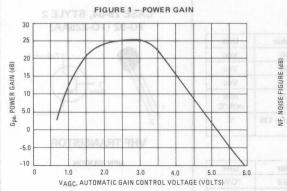
THERMAL CHARACTERISTICS

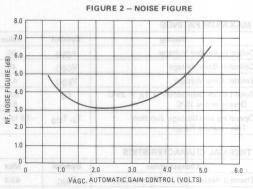
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R_{θ} JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	200	°C/W

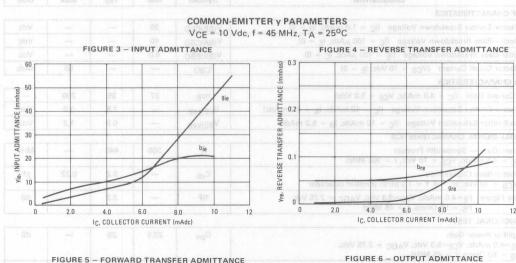
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V _(BR) CEO	30	_		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc$, $I_E = 0$)	V _(BR) CBO	40	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	4.0	- E SRUE	-	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)	Ісво		-	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 4.0 mAdc, V _{CE} = 5.0 Vdc)	hFE	27	35	200	1 - 4
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 5.0 mAdc)	VCE(sat)		1.5	3.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 5.0 mAdc)	V _{BE(sat)}	_	0.9	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (IC = 4.0 mAdc, VCE = 10 Vdc, f = 100 MHz)	fT	300	440	-	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz) (Emitter Guarded)	C _{cb}	-7	0.2	0.22	pF
Noise Figure ($I_E \approx 4.0 \text{ mAdc}$, $V_{CE} \approx 9.3 \text{ Vdc}$, $V_{AGC} = 2.75 \text{ Vdc}$, $R_S = 50 \text{ Ohms}$, $f = 45 \text{ MHz}$)	NF	- 1	3.3	-	dB
FUNCTIONAL TEST (Am) TW3ARU3 NUT39.1380 51	(5840)	A THERMALIS R	0.1081100 01		
Amplifier Power Gain ($IE\approx4.0$ mAdc, $VCE\approx9.3$ Vdc, $VAGC=2.75$ Vdc, $RS=50$ Ohms, $f=45$ MHz)	Gpe	22.5	25	_	dB
Forward AGC Voltage (Gain Reduction = 30 dB, R _S = 50 Ohms, f = 45 MHz)	VAGC	SEMANT C	5.5	9 4 8 9 3 1	Vdc
SUMMARY-COMMON EMITTER PARAMETERS (VCE = 10 Vdc, IC = 4.0 m	Adc, f = 45 MHz)	Committee of the			FWIII
Input Conductance	9ie		6.0		mmhos
Input Capacitance	C _{ieo}	4	33	_	pF
Forward Transfer Admittance Magnitude	Yfe	/	110	-	mmhos
Forward Transfer Admittance Phase Angle	<yfe< td=""><td>1-</td><td>- 22</td><td>1</td><td>Degree</td></yfe<>	1-	- 22	1	Degree
Feedback Capacitance	C _{re}		0.2		pF
Output Conductance	9oe	980	20		μmhos
Output Capaticance	Coe	_	1.4		pF
Maximum Unilateralized Power Gain	G _{um}	-	44	-	dB
$G_{um} = \frac{ y_{fe} ^2}{4 g_{ie} g_{oe}}$	91 00			2.3	4

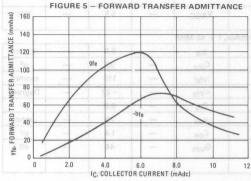
AGC CHARACTERISTICS

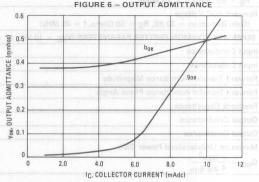
V_{CC} = 12 Vdc, R_S = 50 Ohms, f = 45 MHz, See Figure 10



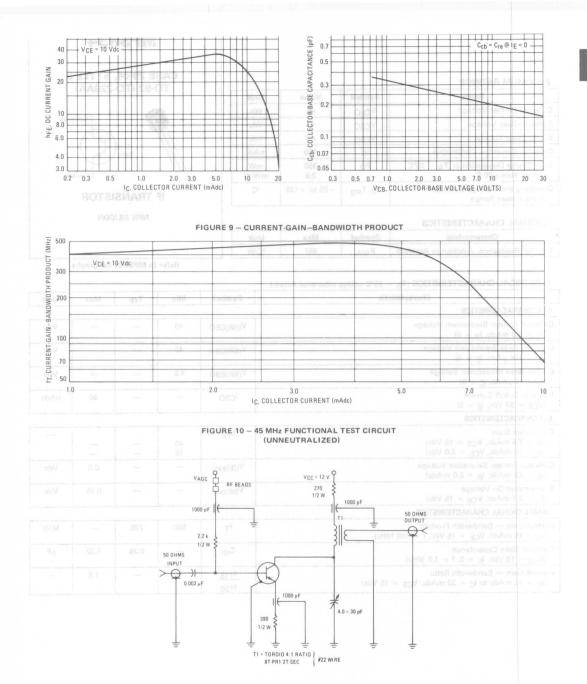








MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



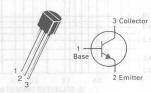
WAXIWOW RATINGS			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	45	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC	100	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +135	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	357	°C/W

MPSH34

CASE 29-04, STYLE 2 TO-92 (TO-226AA)



IF TRANSISTOR

NPN SILICON

Refer to MPSH24 for graphs.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					1 1
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO	45			Vdc
Collector-Base Breakdown Voltage (I _C = 100 µAdc, I _E = 0)	V(BR)CBO	45		-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	4.0		<u> </u>	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	СВО	-	-	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 7.0 mAdc, V_{CE} = 15 Vdc) (I _C = 20 mAdc, V_{CE} = 2.0 Vdc)		40 15		=	_
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	VCE(sat)	<u>-</u>		0.5	Vdc
Base-Emitter On Voltage (I _C = 7.0 mAdc, V _{CE} = 15 Vdc)	VBE(on)	-		0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS	1	(100)			
Current-Gain — Bandwidth Product (I _C = 15 mAdc, V _{CE} = 15 Vdc, f = 100 MHz)	fτ	500	720	-	MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	C _{cb}	20400.0±	0.25	0.32	pF
Current-Gain — Bandwidth Ratio ($I_C = 15 \text{ mAdc}$ to $I_C = 20 \text{ mAdc}$, $V_{CE} = 15 \text{ Vdc}$)	<u>f_{T15}</u> f _{T20}	45000	-	1.6	_

Rating	Symbol	Value	Unit
Rating	Symbol	value	Unit
Collector-Emitter Voltage	VCEO	80	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC	100	mAdc
Total Device Dissipation @ TA = 25°C	PD	625	mW
Derate above 25°C		5.0	mW/°C
Total Device Dissipation (a T _C = 25°C	PD	ebV 1.5	Watt
Derate above 25°C		12	mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Collector-Base Capacitance (V_{CB} = 10 Vdc, f = 1.0 MHz)

 $(I_C = 1.5 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$

(IC = 1.5 mAdc, VCE = 10 Vdc, RS = 50 ohms, f = 1.0 MHz) MPSH54

Output Admittance

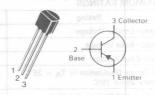
Noise Figure

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	200	°C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

MPSH54 MPSH55

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

pF

μmhos

dB

1.6

15

2.0

Char	acteris	tic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						215	MCTERISTR	VAHO - 1
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	29	озр(ва)У		V(BR)CEO	80	doven Vols	enitter Bres	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	20	080(88)V		V _(BR) CBO	80	geria V nwo	ase breakd	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)	3.0	083(AB)V		V(BR)EBO	4.0	vit. Voltage	obslee 6 ea	Vdc
Collector Cutoff Current (VCB = 60 Vdc, I _E = 0)		[680		ICBO	_	- n	50	nAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)	*	043		IEBO	_	- (0 -	50	nAdc
ON CHARACTERISTICS						2	onserval	School of
DC Current Gain (I _C = 1.5 mAdc, V _{CE} = 10 Vdc)	00	336	MPSH54 MPSH55	hFE	30 30	abV 01 =	120 150	mer t uu o
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		VCE(sat)		V _{CE(sat)}	_ eg	bArn 8.0	0.25	Vdc
SMALL-SIGNAL CHARACTERISTICS		V BE(GR)				= 10 Vdc	moude Ver	J.S.
Current-Gain — Bandwidth Product (IC = 1.5 mAdc, VCF = 10 Vdc, f =	= 100	MHz)		fT	80 80	TalesTOA	AHO JAVIO	MHz

 C_{cb}

hoe

NF

iii otiiii oii iotiii oo			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	7 Wm 20	○ Vdc
Collector-Base Voltage	VCBO	#16W 20	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.81	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

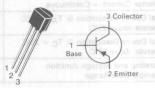
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	357	olu ∘C\W

CASE 29-04, STYLE 2

Symbol

WAXEFURN SALVERS AND SERVICES

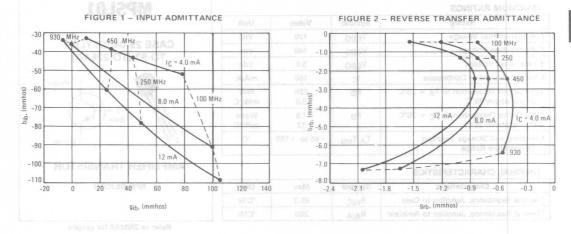


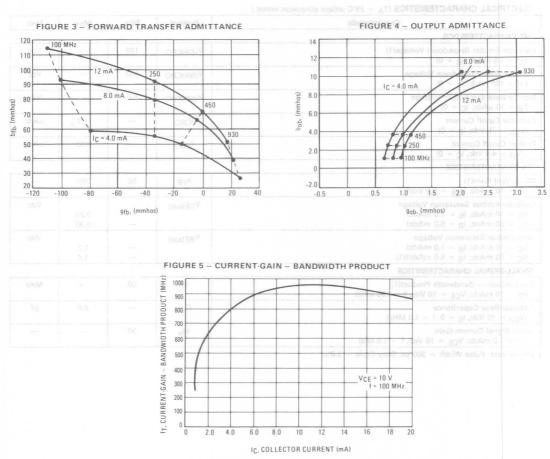
RF AMPLIFIER TRANSISTOR

PNP SILICON

rial xxx qv1 Char	acteris	tic lodmy#		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			A STATE OF THE PARTY				meinaros.	PARES TO
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	08	Veniceo		V(BR)CEO	20	(0 =	gr, obAm	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	08	OBO(BB)V		V(BR)CBO	20	eganov nwo	JAAde, lg	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	0.4	083(88)V		V(BR)EBO	3.0	egszloV av	gl "BA ₄ (Vdc
Collector Cutoff Current (VCB = 10 Vdc, I _E = 0)		080		Ісво	_	(0	100	nAdc
Emitter Cutoff Current (VBE = 2.0 Vdc, I _C = 0)		083		IEBO		_(0 =	100	nAdc
ON CHARACTERISTICS							al estra roy	CONTRACTOR OF
DC Current Gain (I _C = 5.0 mAdc, V _{CE} = 10 Vdc)	DE	397	MPSHS4	hFE	60	(66)V 0T =	aV ,DDAm	t = 0
Collector-Emitter Saturation Voltage (I _C = 5.0 mAdc, I _B = 0.5 mAdc)		VCE(sat)		VCE(sat)		ation Voltag	0.5	Vdc
Base-Emitter On Voltage (I _C = 5.0 mAdc, V _{CE} = 10 Vdc)				V _{BE(on)}	8	ACTERISTIC	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	08	TV IV		/esti	M 001 - 3	noon Produce	asV ob Act	E f = Al
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f =	= 100	MHz)		fT	600		lineq s O ass	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MH	Hz)	non		C _{cb}	dan t = 1	SBV OT =	0.85	pF ₁
Collector-Emitter Capacitance (IR = 0, VCR = 10 Vdc, f = 1.0 MH	Hz)	PIM		C _{ce}		-	0.65	pF







MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

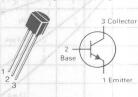
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	120	Vdc
Collector-Base Voltage	VCBO	140	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	150	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPSL01

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N5550 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

BOMATTMAGA TUGTUO Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, I _B = 0)	V(BR)CEO	120	1	Vdc
Collector-Base Breakdown Voltage (IC = 100 μAdc, IE = 0)	V(BR)CBO	140		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μ Adc, I _C = 0)	V _{(BR)EBO}	5.0		Vdc
Collector Cutoff Current (V _{CB} = 75 Vdc, I _E = 0)	СВО		1.0	μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	IEBO	Att 6.4	100	nAdc
ON CHARACTERISTICS				
DC Current Gain(1) (IC = 10 mAdc, V _{CE} = 5.0 Vdc)	hFE	50	300	20
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)	VCE(sat)	(toffato)_g(s)	0.20 0.30	Vdc
Base-Emitter Saturation Voltage ($I_C = 10$ mAdc, $I_B = 1.0$ mAdc) ($I_C = 50$ mAdc, $I_B = 5.0$ mAdc)(1)	VBE(sat)	_	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS	HOURE 5 - CURRE			
Current-Gain — Bandwidth Product(1) (IC = 10 mAdc, VCE = 10 Vdc, f = 100 MHz)	fT	60	-	MHz
Collector-Base Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MHz)	C _{cb}	_	8.0	pF
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{fe}	30	_	_

TYPICAL COMMON-BASE Y-PARAMETERS (VCB - 10 Vdc, TA - 25°C, Frequency Points in MHz)

(1) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

MAXIMOM NATINGS					
Rating	Symbol	Value	Unit		
Collector-Emitter Voltage	VCEO	100	Vdc		
Collector-Base Voltage	Vсво	100	Vdc		
Emitter-Base Voltage	VEBO	by 4.0	Vdc		
Collector Current — Continuous	Ic	600	mAdc		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12.0	Watts mW/°C		
Operating and Storage Junction	TJ, T _{stg}	-55 to +150	n ad °C		

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W

MPSL51

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N5400 for graphs.

ELECTRICAL	CHARACTERISTICS	(TA =	25°C unless	otherwise	noted.)

Characteri	stic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		The state of the s	in the same of the	SECRETARIA DE	nei i i
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)		V(BR)CEO	100	esenti rezilmi	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	MPSW01A	V _(BR) CBO	100	-	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	MPSW01A	V(BR)EBO	4.0	gra na n oo	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)	V.	ICBO		ase d 0.f atidos	μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	-MPSWo1	IEBO	- 7	periu100 30 Vdc. ig =	nAdc
ON CHARACTERISTICS(1)	MPSW01A		(0)	46 Vdc, Ig =	= aov;
DC Current Gain(1) UC = 50 mAdc, VCE = 5.0 Vdc)		hFE	40	250	O par <u>tan</u> ră Hi sajVI
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)		VCE(sat)	3(1) = 1. 0 V de3	0.25 0.30	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{BE} (sat)	1.0 Vdc = 1.0 Vdc	000 12.1 dc. Vo	Vdc
SMALL-SIGNAL CHARACTERISTICS	V			ai abAm 000	ropski 3 f -
Current-Gain — Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f = 100 MH		fT	60	ter Gin_Voltag 300 mAde, V	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz)		C _{obo}		AH 8.0	pF
Small-Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$!)	h _{fe}		n mAde, Ves	ë = <u>pil</u> Cuppet D
) Pulse Test: Pulse Test = 300 μs, Duty Cycle	= 2.0%.	(12)	M 0.1 = 1.0 M	10 Velc, lg =	

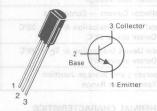
Rating	Symbol	Value	Unit
Collector-Emitter Voltage MPSW01 MPSW01A	VCEO	30 40	Vdc
Collector-Base Voltage MPSW01 MPSW01A	VCBO	40 50	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	lc o	1000	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	· c

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPSW01 MPSW01A

CASE 29-03, STYLE 1 TO-92 (TO-226AE)

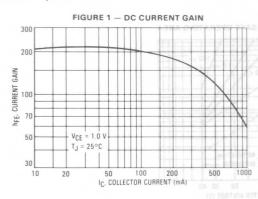


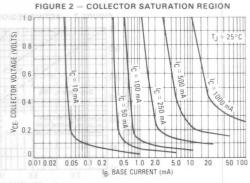
HIGH CURRENT TRANSISTOR

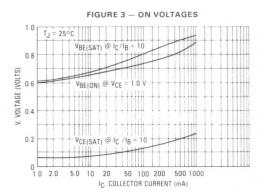
NPN SILICON

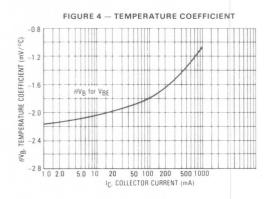
Characteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS				- 6	JI I SING I JA	15 80 440
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	(1) ^{ED(BB)V} OBO(BB)V	MPSW01 MPSW01A	V _(BR) CEO	30	midde street e gli obAm i objection sand	Vdc
Collector-Base Breakdown Voltage $(I_{C} = 100 \mu Adc, I_{E} = 0)$	Ов∋(яв) ^V	MPSW01 MPSW01A	V(BR)CBO	40	votolsaria az e ol -o bAu	Vdc E-mitter-B (lg = 1)
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	080		V(BR)EBO	5.0	utor(<u>ut</u> urrer 50 Vdc, (g. =	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 40 Vdc, I _E = 0)	OE3	MPSW01 MPSW01A	СВО	(0 (p)s	0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)	394		IEBO	- 5.0 Vdel	(0.1 _i , j)	μAdc
ON CHARACTERISTICS(1)	(Personal V			ation Voltage	mitter Service	Collector-
DC Current Gain (IC = 10 mAdc, V _{CE} = 1.0 Vdc) (IC = 100 mAdc, V _{CE} = 1.0 Vdc)	(ree)36V		hFE	55 0.0 60 54 7	mAdb, Ig = mA da, Ig = er Sateratio	
(I _C = 1000 mAdc, V _{CE} = 1.0 Vdc) Collector-Emitter Saturation Voltage (I _C = 1000 mAdc, I _B = 100 mAdc)			VCE(sat)	(ab. 50 ac.)	0.5	Vdc
Base-Emitter On Voltage (I _C = 1000 mAdc, V _{CE} = 1.0 Vdc)			VBE(on)	idth Froduct	nons 1.2 ns	Vdc
SMALL-SIGNAL CHARACTERISTICS	adn3				donarioso	eC. hyatnO
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f =	20 MHz)		fT (SHI	/ 0.1 50 1.0	e gl. pav (); of Current C	MHz
Output Capacitance (VCB = 10 Vdc, IF = 0, f = 1.0 MH	Hz)		C _{obo}	= 102Vd6, f	20 20 mg	pF

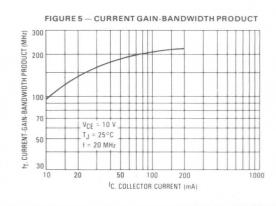
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

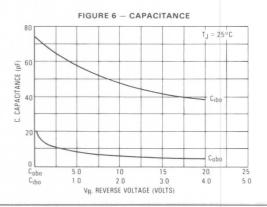


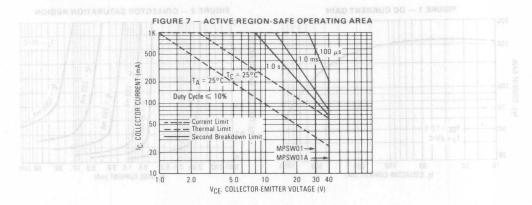


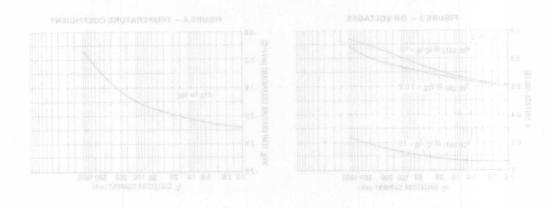


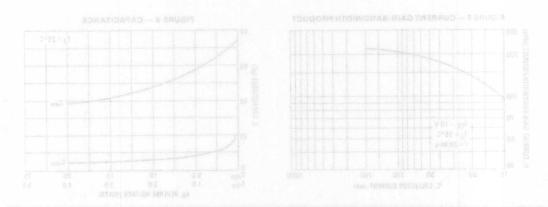












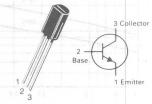
IVIAAIIVIOIVI HATIIVOS				150.00
Rating	Symbol	MPSW05	MPSW06	Unit
Collector-Emitter Voltage	VCEO	60	80	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	4	.0	Vdc
Collector Current — Continuous	IC	500		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	125	°C/W

MPSW05 MPSW06

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



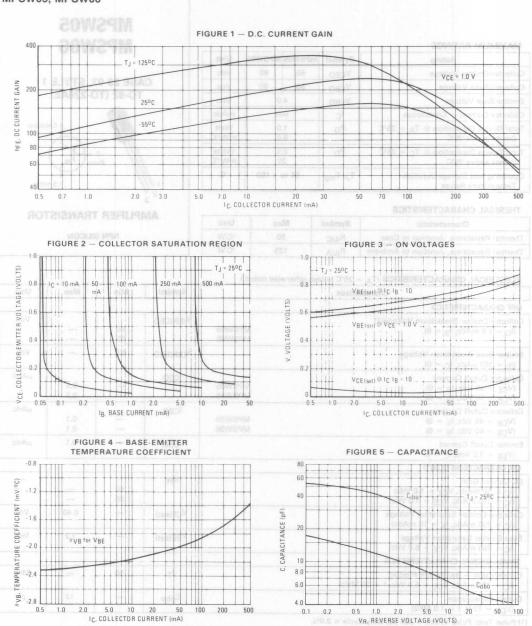
AMPLIFIER TRANSISTOR

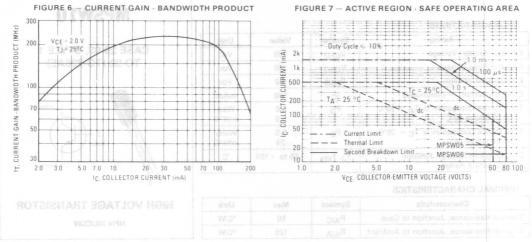
NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					11.
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	MPSW05 MPSW06	V(BR)CEO	60 80		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)		V(BR)EBO	4.0	/	Vdc
Collector Cutoff Current (V _{CE} = 40 Vdc, I _B = 0) (V _{CE} = 60 Vdc, I _B = 0)	MPSW05 MPSW06	ICEO		0.5 0.5	μAdc
Collector Cutoff Current (VCB = 40 Vdc, IE = 0) (VCB = 60 Vdc, IE = 0)	MPSW05 MPSW06	Ісво	PARIO 38A8 6	0.1 0.1	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0) ASA3 - 3 SUSIN			e a — base rature ce		μAdc
ON CHARACTERISTICS(1)					
DC Current Gain (IC = 50 mAdc, V _{CE} = 1.0 Vdc) (IC = 250 mAdc, V _{CE} = 1.0 Vdc)		hFE	80 60	_	-
Collector-Emitter Saturation Voltage $(I_C = 250 \text{ mAdc}, I_B = 10 \text{ mAdc})$	3 14	VCE(sat)		0.40	Vdc
Base-Emitter Saturation Voltage (IC = 250 mAdc, VCE = 5.0 Vdc)	MATION	V _{BE(sat)}		1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS	700		The same of the sa		
Current-Gain — Bandwidth Product (I _C = 200 mAdc, V _{CE} = 5.0 Vdc, f = 20 MHz)	G .	f _T	50	_	MHz
Output Capacitance (VCB = 10 V, f = 1.0 MHz)	200 500	C _{obo}	W 9.2	12	pF

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.





Refer to MPSW42 for graphs.

		TOTAL CO. A. CO. CO.	
		IN CHANGE STATE DAY	

		xnlVl	
B-J-MANE			

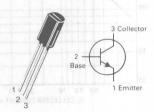
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	300	Vdc
Collector-Base Voltage	VCBO	300	Vdc
Emitter-Base Voltage	VEBO	- 6.0	Vdc
Collector Current — Continuous	IC	500	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Total Device Dissipation (a: T _C = 25°C Derate above 25°C	PD-	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPSW10

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



HIGH VOLTAGE TRANSISTOR

NPN SILICON

Refer to MPSW42 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	300	-	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	V(BR)CBO	300	_	Vdc
Emitter-Base Breakdown Voltage ($I_E=100~\mu Adc,~I_C=0$)	V(BR)EBO	6.0	-	Vdc
Collector Cutoff Current (V _{CB} = 200 Vdc, I _E = 0)	СВО		0.2	μAdc
Emitter Cutoff Current (VEB = 6.0 Vdc, I _C = 0)	IEBO		0.1	μAdc
ON CHARACTERISTICS(1)				
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 30 mAdc, V _{CE} = 10 Vdc)	hFE	25 40 40	=	_
Collector-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 3.0 mAdc)	VCE(sat)	-	0.75	Vdc
Base-Emitter On Voltage (I _C = 30 mAdc, V _{CE} = 10 Vdc)	VBE(on)	-	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 20 MHz)	fT	45	-	MHz
Collector-Base Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MHz)	C _{cb}		3.0	pF

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

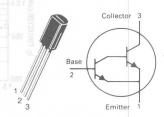
MAXIMOM NATINGS					
Rating	Symbol	Value	Unit		
Collector-Emitter Voltage	VCES	30	Vdc		
Collector-Base Voltage	VCBO	30	Vdc		
Emitter-Base Voltage	VEBO	10	Vdc		
Collector Current — Continuous	lc	1.0	Adc		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20	Watts mW/°C		
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C		

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPSW13 MPSW14

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



DARLINGTON TRANSISTOR

NPN SILICON

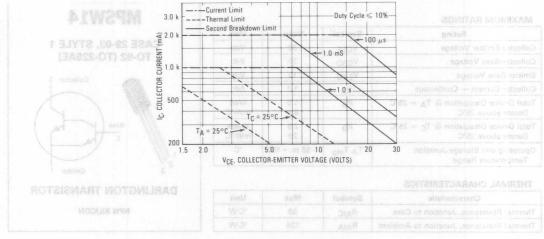
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

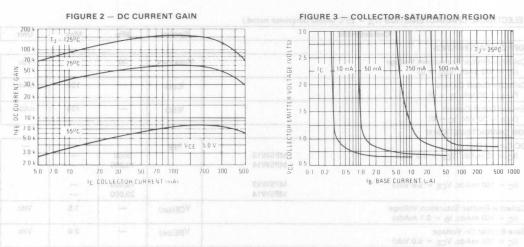
Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS				-	Lyman
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)		V(BR)CES	30	1-11	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)		ІСВО		100	nAdc
Emitter Cutoff Current (VEB = 10 Vdc, IC = 0)		IEBO		100	nAdc
ON CHARACTERISTICS(1)				3,945	
DC Current Gain (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	MPSW13 MPSW14	h x 0 d gav hFE	5000 10,000		
$(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	MPSW13 MPSW14	April 1 Mari	10,000 20,000	=	
Collector-Emitter Saturation Voltage ($I_C = 100 \text{ mAdc}$, $I_B = 0.1 \text{ mAdc}$)		VCE(sat)	_	1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)		V _{BE} (on)	_	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)		fT	125	_	MHz

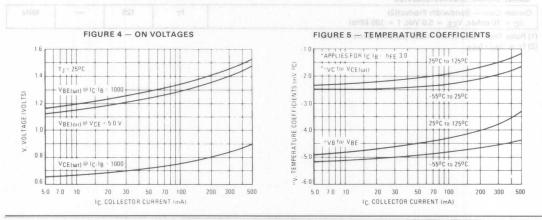
PICURE! - ACTIVE REGION BAFE OPERATING AREA

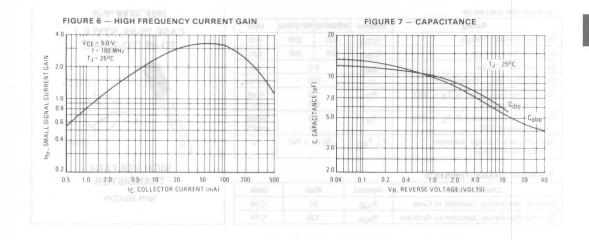
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) $f_T = |h_{fe}| \cdot f_{test}$









		OF CHARACTERISTICS

Conscribses Breskdown Voltage 1 g = 100 pAdc 1g = 01	MPSW42 MPSW43		
		0.0	
	MPSW42 MPSW43		
Bulle Environ Saturation Voltage 2.29 mAde, 1g = 2:0 mAdo)			

11 Street - st. Pulse Width & 300 ns. Daty Ords \$ 2.0%

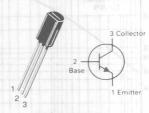
Rating	Symbol	MPSW42	MPSW43	Unit
Collector-Emitter Voltage	VCEO	300	200	Vdc
Collector-Base Voltage	VCBO	300	200	Vdc
Emitter-Base Voltage	VEBO	6	.0	Vdc
Collector Current — Continuous	IC	500		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 8.0		Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	2.5 20		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 to	o +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W



CASE 29-03, STYLE 1 TO-92 (TO-226AE)



HIGH VOLTAGE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Characteristic		Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) $(I_C = 1.0 \text{ mAdc}, I_B = 0)$	MPSW42 MPSW43	V(BR)CEO	300 200		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	MPSW42 MPSW43	V(BR)CBO	300 200	=	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc$, $I_C = 0$)		V _{(BR)EBO}	6.0		Vdc
Collector Cutoff Current $(V_{CB} = 200 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 160 \text{ Vdc}, I_{E} = 0)$	MPSW42 MPSW43	Ісво	=	0.1 0.1	μAdc
Emitter Cutoff Current ($V_{EB} = 6.0 \text{ Vdc}, I_{C} = 0$) ($V_{EB} = 4.0 \text{ Vdc}, I_{C} = 0$)	MPSW42 MPSW43	IEBO	=	0.1	μAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 30 mAdc, V _{CE} = 10 Vdc)	Both Types Both Types MPSW42 MPSW43	hFE	25 40 40 40	=	_
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	MPSW42 MPSW43	VCE(sat)	=	0.5 0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		V _{BE(sat)}	_	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 20 MHz)		fT	50		MHz
Collector-Base Capacitance $(V_{CB} = 20 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$	MPSW42 MPSW43	C _{cb}	=	3.0 4.0	pF

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

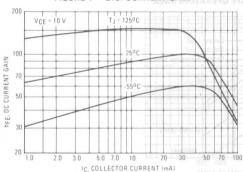


FIGURE 1 - D.C. CURRENT GAIN TARREST STATE FIGURE 2 - COLLECTOR SATURATION REGION

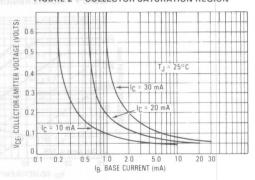


FIGURE 3 - ON VOLTAGES

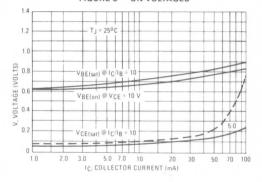


FIGURE 4 — TEMPERATURE COEFFICIENTS

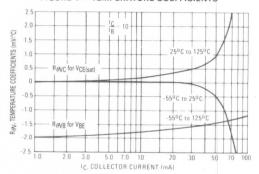


FIGURE 5 - CAPACITANCE

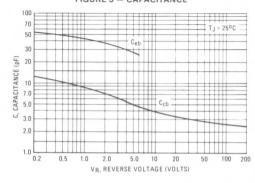
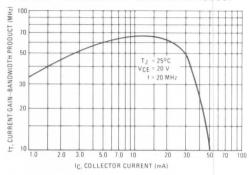
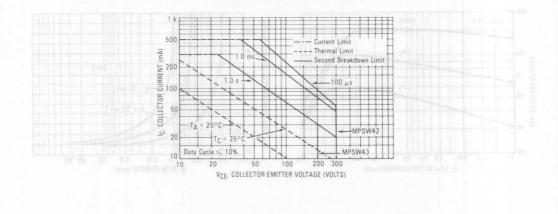
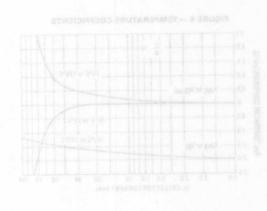
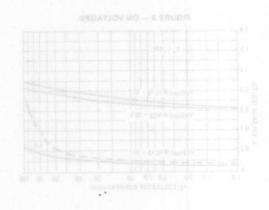


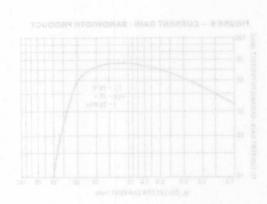
FIGURE 6 - CURRENT GAIN - BANDWIDTH PRODUCT

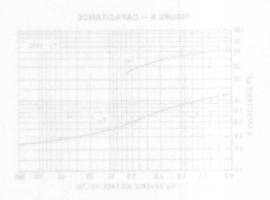








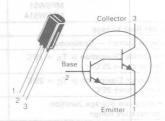




MAXIMUM RATINGS			
Rating	Symbol	Value	04 Unit
Collector-Emitter Voltage	VCES	obV 40	Vdc
Collector-Base Voltage T SC-OT	VCBO	50	Vdc
Emitter-Base Voltage	VEBO	12	Vdc
Collector Current — Continuous	Ic	1.0	Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Total Device Dissipation $(a T_C = 25^{\circ}C)$ Derate above 25°C	PD	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	or 68

MPSW45

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



THERMAL CHARACTERISTICS

AOT 312 Characteristic ARUS HO	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R_{θ} JC	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N6426 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Cha	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	South Figure				ROTERISTICS	MAAHO E
Collector-Emitter Breakdown Voltage (I _C = 100 µAdc, V _{BE} = 0)	VIBRICEO	15/6/0/444	V(BR)CES	lage 40 nw	inter Br eakdu mAdo lo = f	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)			V _(BR) CBO	50	oumboissach as	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	080(88)	MESWS1 MESWS1A	V(BR)EBO		$0 = g \frac{1}{2} c b A u$	001 Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	Овэ(яв)У		СВО	Volta ge	mwc100 m8 0 = gl .pbAx	nAdc
Emitter Cutoff Current (VEB = 10 Vdc, I _C = 0)			IEBO	_	toff (001 ent 1 /cc, lg = 0	nAdc
ON CHARACTERISTICS(1)) y ((c, (g = 0)	개 : 88*
DC Current Gain (IC = 200 mAdc, VCE = 5.0 Vdc) (IC = 500 mAdc, VCE = 5.0 Vdc) (IC = 1.0 Adc, VCE = 5.0 Vdc)	083		hFE	25,000 15,000 4,000	150,000	MARAHA I
Collector-Emitter Saturation Voltage (I _C = 1.0 Adc, I _B = 2.0 mAdc)	240		VCE(sat)	1.0 V dc) 1.0 Vdc)	Adc 2/15 = =	Vdc
Base-Emitter Saturation Voltage (I _C = 1.0 Adc, I _B = 2.0 mAdc)			V _{BE} (sat)	labV 0.1 =	2.0	Vdc
Base-Emitter On Voltage (I _C = 1.0 Adc, V _{CE} = 5.0 Vdc)	Vaeton		VBE(on)	(shAm 001	2.0 Am	Vdc
SMALL-SIGNAL CHARACTERISTICS				100 Vdot	HADV JOBAN I	1001
Current-Gain — Bandwidth Product (I _C = 200 mAdc, V _{CE} = 5.0 Vdc, f =	100 MHz)	Observation of the Park Control of the Park Co	fT	100	HAL CHARAC Bandwidt	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz	Coton		C _{cb}	= 1, <u>3b</u> V 07	6.0	pF

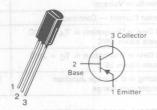
Rating		Symbol	Value	Unit
Collector-Emitter Voltage	MPSW51 MPSW51A	VCEO	30 May 40	Vdc
Collector-Base Voltage	MPSW51 MPSW51A	VCBO	55V 40 50	Vdc
Emitter-Base Voltage		VEBO	5.0	Vdc
Collector Current — Contin	nuous	Ic	1000	mAdc
Total Device Dissipation @ Derate above 25°C	$T_A = 25^{\circ}C$	PD	1.0 8.0	Watt mW/°C
Total Device Dissipation @ Derate above 25°C	$T_C = 25^{\circ}C$	PD	2.5 20	Watts mW/°C
Operating and Storage Jur Temperature Range	nction	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	125	°C/W

MPSW51 MPSW51A

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



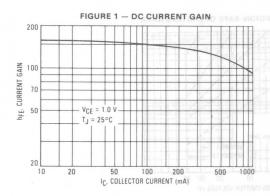
HIGH CURRENT TRANSISTOR

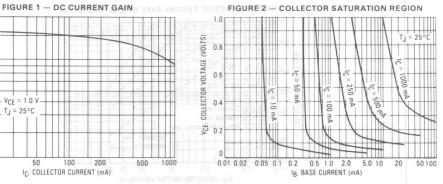
PNP SILICON

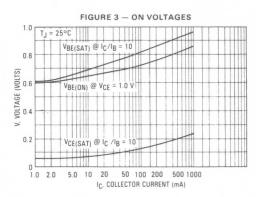
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

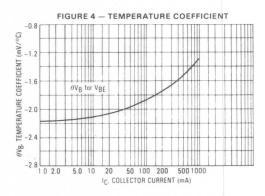
tinU walki neki Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CONTROLL.	in party to
Collector-Emitter Breakdown Voltage(1 (I _C = 1.0 mAdc, I _B = 0)) SED(RE) V	MPSW51 MPSW51A	V(BR)CEO	30 40	rei erailidea Add, Vigg = Srealidown	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	QESISSI ^V	MPSW51 MPSW51A	V(BR)CBO	40 50	Great <u>ed</u> dwn do, l <u>e</u> = 0).	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc$, $I_C = 0$)	080		V _{(BR)EBO}	5.0	off Current Vdc, $l_{\rm E}=0$	V GC
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 40 Vdc, I _E = 0)	083	MPSW51 MPSW51A	Ісво		0.1	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0)	337		IEBO	5.0 Vetei	0.1	μAdc
ON CHARACTERISTICS(1)				(aby 0.8	= ggV abAr	u 209 = 21
DC Current Gain $(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 1000 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	(1812)30 ¹⁰		hFE		ot 900 miles do 1922 2.0 do 1922 2.0 Satur in con V	A 1.1 = Ol
Collector-Emitter Saturation Voltage (I _C = 1000 mAdc, I _B = 100 mAdc)	resizeV		V _{CE(sat)}	<u>-tr</u> isAni	0.7	Vdc
Base-Emitter On Voltage (I _C = 1000 mAdc, V _{CE} = 1.0 Vdc)			V _{BE} (on)	O Veol.	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS	nt I			Product	bbiwbns8 -	read men
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f =	20 MHz)		68 f _T 1 003	50	- ggV shar	MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MHz)		C _{obo}	SHM <u>D.F</u> = 1 O en 00E e	30	pF

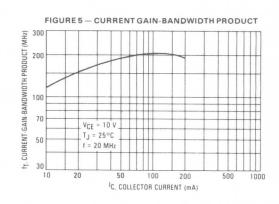
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

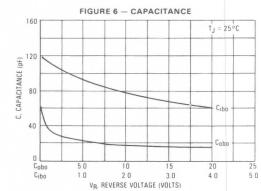




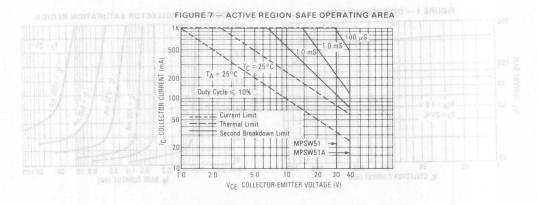


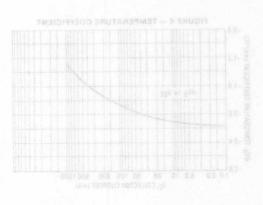


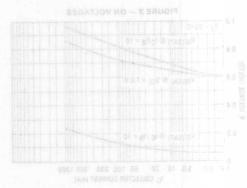


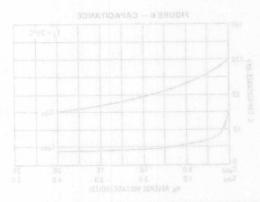


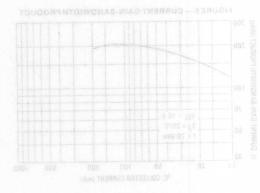
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS











Rating	Symbol	MPSW55	MPSW56	Unit
Collector-Emitter Voltage	VCEO	60	80	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	4	.0	Vdc
Collector Current — Continuous	lc	500		mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	1.0		Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	2.5 20		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 to	-55 to +150	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPSW55 MPSW56

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



AMPLIFIER TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	MPSW55 MPSW56	V(BR)CEO	60 80		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)		V(BR)EBO	4.0	≥ Am UI -	Vdc
Collector Cutoff Current (V _{CE} = 40 Vdc, I _B = 0) (V _{CE} = 60 Vdc, I _B = 0)	MPSW55 MPSW56	ICEO	=	0.5 0.5	μAdc
Collector Cutoff Current $(V_{CB} = 40 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 60 \text{ Vdc}, I_E = 0)$	MPSW55 MPSW56	СВО		0.1 0.1	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0)	IEBO	S BASE CURRES	0.1	μAdc	
ON CHARACTERISTICS(1)					
DC Current Gain (I _C = 50 mAdc, V_{CE} = 1.0 Vdc) (I _C = 250 mAdc, V_{CE} = 1.0 Vdc)		hFE	80 50	_	_
Collector-Emitter Saturation Voltage (I _C = 250 mAdc, I _B = 10 mAdc)	VCE(sat)	_	0.5	Vdc	
Base-Emitter On Voltage (I _C = 250 mAdc, V _{CE} = 5.0 Vdc)	V _{BE} (on)	IE 4 - EAS	1.2 NOR	Vdc	
SMALL-SIGNAL CHARACTERISTICS		THIS LOT WAS C	D SHULAN	3-110-31	
Current-Gain — Bandwidth Product (I _C = 250 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	(1)	f _T	50		MHz
Output Capacitance (VCB = 10 Vdc, f = 1.0 MHz)	02	C _{obo}	-	15	pF

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

FIGURE 1 - D.C. CURRENT GAIN

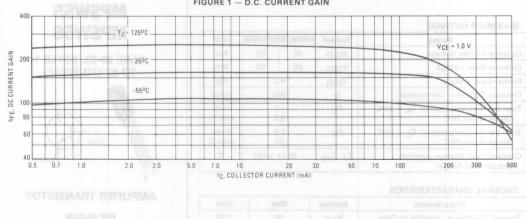
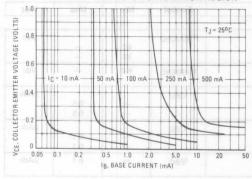


FIGURE 2 - COLLECTOR SATURATION REGION



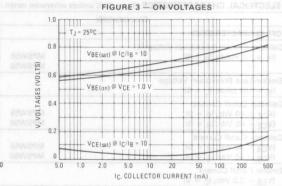


FIGURE 4 - BASE-EMITTER TEMPERATURE COEFFICIENT

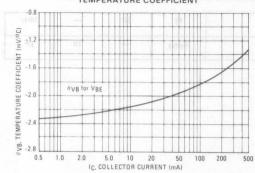
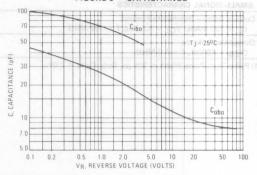


FIGURE 5 - CAPACITANCE





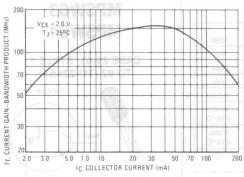
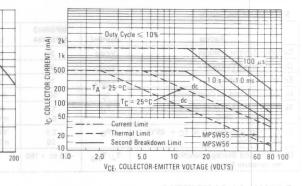


FIGURE 7 - ACTIVE REGION - SAFE OPERATING AREA



| Deter assured assign STRE | AT ROTTERSTOARANG LADI)

Rating	Symbol	MPSW63 MPSW64	Unit
Collector-Emitter Voltage	VCES	30	Vdc
Collector-Base Voltage	Vсво	00.30	Vdc
Emitter-Base Voltage	VEBO	10	Vdc
Collector Current — Continuous	Ic	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD -	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	000 °C 0

CASE 29-03, STYLE 1 TO-92 (TO-226AE) Collector 3 Base 2 DARLINGTON TRANSISTOR

PNP SILICON

MPSW64

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)		V(BR)CES	30	-	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)		ICBO	-	100	nAdc
Emitter Cutoff Current . (VEB = 10 Vdc, I _C = 0)		IEBO	_	100	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain ($I_C = 10 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$)	MPSW63 MPSW64	hFE	5,000 10,000	=	-
$(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	MPSW63 MPSW64		10,000 20,000	=	
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 0.1 mAdc)		VCE(sat)	_	1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)		V _{BE} (on)	-	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)		fT	125	1	MHz

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ $f_T = |h_{fe}| \cdot f_{test}$.

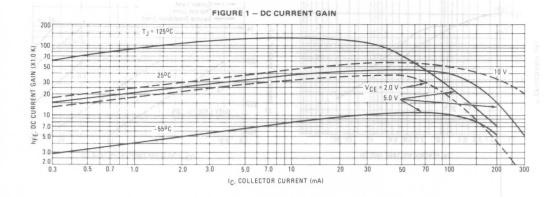


FIGURE 2 - "ON" VOLTAGE

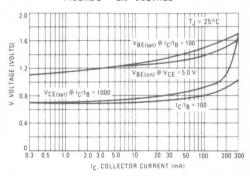


FIGURE 3 - COLLECTOR SATURATION REGION

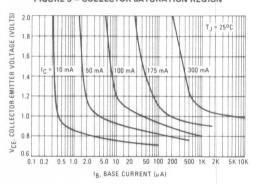


FIGURE 4 - TEMPERATURE COEFFICIENTS

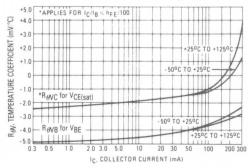
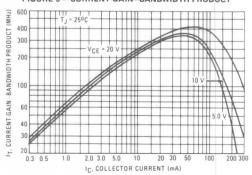
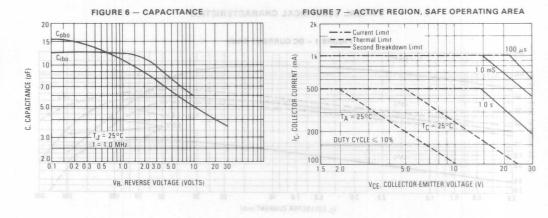
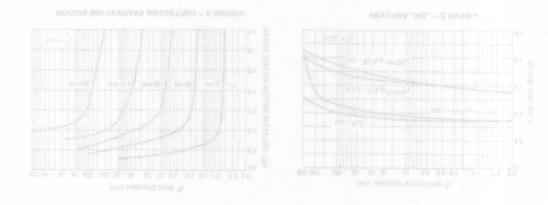
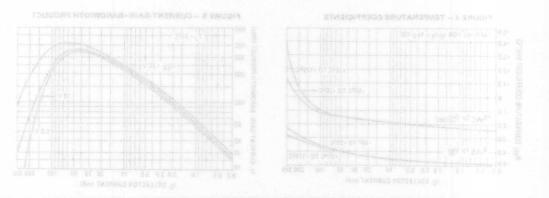


FIGURE 5 - CURRENT-GAIN-BANDWIDTH PRODUCT









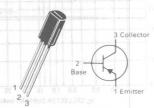
Rating	Symbol	MPSW92	MPSW93	Unit
Collector-Emitter Voltage	VCEO	300	200	Vdc
Collector-Base Voltage	Vсво	300	200	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	lc	500		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 8.0		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 2	.5 20	Watts mW/°C
Operating and Storage Junction	TJ, T _{stg}	- 55 to	+ 150	l (°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	50	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	125	°C/W

MPSW92

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



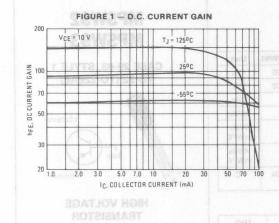
HIGH VOLTAGE **TRANSISTOR**

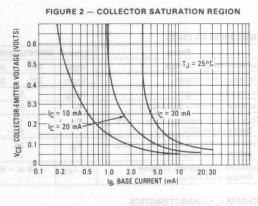
PNP SILICON

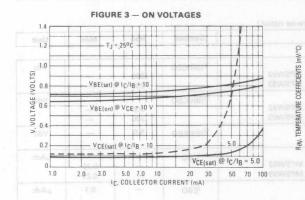
FIGURE 3 - ON VOLTAGES

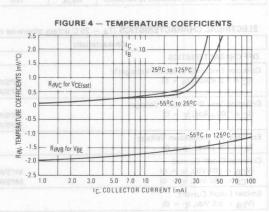
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

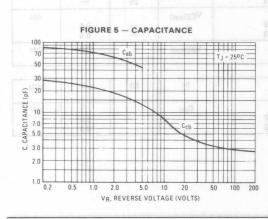
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS				4	
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	MPSW92 MPSW93	V(BR)CEO	300 200	(to)98 <u>V</u>	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	MPSW92 MPSW93	V(BR)CBO	300 200	(ao138¥_	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)		V(BR)EBO	5.0	nesianV —	Vdc
Collector Cutoff Current $(V_{CB} = 200 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 160 \text{ Vdc}, I_E = 0)$	MPSW92 MPSW93 66 65	ICBO	50 70 10	0.25 0.25	μAdd
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)			ap Horizakatio a	0.1	μAdo
ON CHARACTERISTICS(1)		1			
DC Current Gain $ \begin{pmatrix} I_C = 1.0 \text{ mAdc, V}_{CE} = 10 \text{ Vdc} \end{pmatrix} $ $ \begin{pmatrix} I_C = 10 \text{ mAdc, V}_{CE} = 10 \text{ Vdc} \end{pmatrix} $ $ \begin{pmatrix} I_C = 30 \text{ mAdc, V}_{CE} = 10 \text{ Vdc} \end{pmatrix} $	Both Types Both Types MPSW92 MPSW93	hFE	25 40 25 25	=	_
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	MPSW92 MPSW93	VCE(sat)	5 - CAPAC	0.5 0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		V _{BE} (sat)	163	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 20 MHz)		fT	50		MHz
Collector-Base Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MHz)	MPSW92 MPSW93	C _{cb}		6.0 8.0	pF

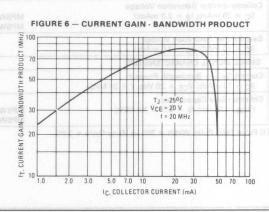




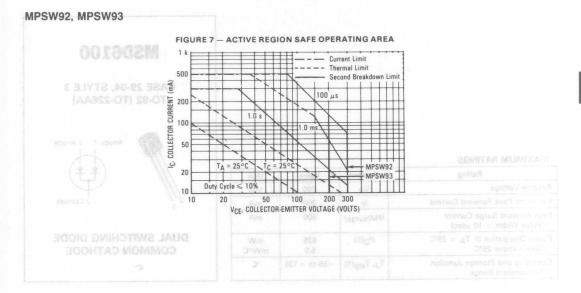












1 for more package improvements have enhanced these guaranteed Maximum Ratings as follows: PD = 1.0 W (in TC = 25°C).

MSD6100

CASE 29-04, STYLE 3 TO-92 (TO-226AA)





DUAL SWITCHING DIODE COMMON CATHODE

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Reverse Voltage	VR	100	Vdc
Recurrent Peak Forward Current	IF OUR	200	mA
Peak Forward Surge Current (Pulse Width = 10 μsec)	IFM(surge)	500	mA
Power Dissipation @ T _A = 25°C Derate above 25°C	P _D (1)	625 5.0	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg} (1)	-55 to +135	°C

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
Breakdown Voltage (I(BR) = 100 µAdc)	V _(BR)	100	-	Vdc
Reverse Current (V _R = 100 Vdc) (V _R = 50 Vdc) (V _R = 50 Vdc, T _A = 125°C)	l _R	Ξ	5.0 0.1 20	μAdc
Forward Voltage (IF = 1.0 mAdc) (IF = 10 mAdc) (IF = 100 mAdc)	V _F	0.55 0.67 0.75	0.7 0.82 1.1	Vdc
Capacitance (V _R = 0)	С	-	1.5	pF
Reverse Recovery Time $(I_F = I_R = 10 \text{ mAdc}, V_R = 5.0 \text{ Vdc}, i_{rr} = 1.0 \text{ mAdc})$	t _{rr}	-	4.0	ns

⁽¹⁾ Continuous package improvements have enhanced these guaranteed Maximum Ratings as follows: $P_D = 1.0 \text{ W} \ @ T_C = 25^{\circ}\text{C}$, Derate above $25^{\circ}\text{C} - 8.0 \text{ mW/°C}$, $T_J = -65 \text{ to } +150^{\circ}\text{C}$, $\theta_{JC} = 125^{\circ}\text{C/W}$.

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CASE 29-04, STYLE 4 TO 92 (TO-226AA)

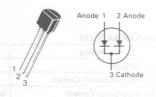
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Reverse Voltage	VR	70	Vdc
Recurrent Peak Forward Current	I _F	200	mA
Peak Forward Surge Current (Pulse Width = 10 μs)	IFM(surge)	99V 500 Am	Am 70
Power Dissipation @ T _A = 25°C Derate above 25°C	P _D (1)	625 5.0	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg} (1)	-55 to +135	asa °C

⁽¹⁾ Continuous package improvements have enhanced these guaranteed Maximum Ratings as follows: PD = 1.0 W @ TC = 25°C, Derate above 25°C — 8.0 mW/°C, TJ = -65 to +150°C, θ JC = 125°C/W.

MSD6102

CASE 29-04, STYLE 3 TO-92 (TO-226AA)



DUAL DIODE COMMON CATHODE

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) noduce assists of experience of the control of t

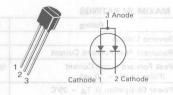
		Characteristic		Symbol	Min	Max	Unit
Breakdown Voltage (I _(BR) = 100 μAdc)		05	(Re)V	V(BR)	70	-egeste* O pAdol	Vdc
Reverse Current (V _R = 50 Vdc)				IR	_		μAdc
Forward Voltage (IF = 10 mAdc)	08.0		ąV	VF	_	1.0 ags (aga)	Vdc
Capacitance (V _R = 0)	6.0		3	С	_	3.0	pF
Reverse Recovery Time (IF = IR = 10 mAdc,		0 Vdc, i _{rr} = 1.0 m	Adc)	trr (abAm 0.7 = m	,apV 0.8 =	90100 9970 V 39Am 01	

ASE 29-04, STYLE 3 TO-92 (TO-226AA)

MAXIMUM BATINGS

IMAXIMOM RATINGS				
Rating	Symbol	Value	oog Unit	
Reverse Voltage	VR	Am 70	oga Vdc	
Peak Forward Recurrent Current	I _F	200	mA	
Peak Forward Surge Current (Pulse Width = 10 μ s)	IFM(surge)	196 500 25 West	828 mA	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	P _D (1)	625 5.0	mW mW°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg} (1)	-55 to +135		

CASE 29-04, STYLE 4 TO-92 (TO-226AA)



DUAL DIODE COMMON ANODE

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) Provide Service (SCS = AT) SOUTS (SERVICE SCORE)

Max Unit	Characteristic (2)	Symbol	Min	Тур	Max	Unit
Breakdown Voltage (I(BR) = 100 μAdc)	V(BB) 76	V(BR)	70	-	agelloV (abAs, 001	Vdc 48
Reverse Current (V _R = 50 Vdc)	- A	IR	_	-	0.1 _{mate}	μAdc
Forward Voltage (IF = 10 mAdc)	- W	V _F	-	0.80	1.0 _{gadia}	Vdc
Capacitance (V _R = 0)	- 3	С		5.0	8.0	napEgac
Reverse Recovery Time (I _F = I _R = 10 mAdc, V	' _R = 5.0 Vdc, i _{rr} = 1.0 mAdc)	t _{rr}	/dc. int = 1	- s.0 Vg = 5.0	100	ns yes

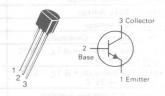
⁽¹⁾ Continuous package improvements have enhanced these guaranteed Maximum Ratings as follows: $P_D = 1.0 \text{ W}$ @ $T_C = 25^{\circ}\text{C}$, $P_D = 10 \text{ W}$ @ $P_D = 125^{\circ}\text{C}$.

Rating	Symbol	PBF259,S	Unit
Collector-Emitter Voltage	VCEO	300	Vdc
Collector-Base Voltage	VCBO	300	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current - Continuous	IC	500	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic OV Mo	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

NPN SILICON

Refer to MPSA42 for graphs.

ELECTRICAL CHARACTERISTICS	naracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS							
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	(1) ^{30(88)V}		100000	V _{(BR)CEO}	300	n AdC lg	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	VIBRICEO			V _(BR) CBO	300	e gl. do un	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	083(38)			V _{(BR)EBO}	5.0	21	Vdc
Collector Cutoff Current (VCB = 250 Vdc, IE = 0)	080			ICBO	- (0	50	nAdc
Emitter Cutoff Current (VEB = 3.0 V)	083			I _{EBO}	_	20	nAdo
Collector Cutoff Current (VCE = 10 V)	0301			ICEO	_	50	nAdd
ON CHARACTERISTICS (1)					(17)	Borrown not	15-15/
DC Current Gain ($I_C = 20 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$) ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$) ($I_C = 30 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$)	340	PBF259S All Types All Types	PEF259AS All Types All Types	hFE	60 25 25	BOV John TOV John BOV John	
Collector-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 1.5 mAdc) (I _C = 30 mAdc, I _B = 60 mAdc)				VCE(sat)	1.5 mAdel 80 mAdel	0.5 1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	VBELSEL				- LAm D	Const Art.	
Current-Gain Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f =	20 MHz)			fT	40	ARAH U JAM	MHz
Output Capacitance (VCB = 20 Vdc, IE = 0, f = 1.0 MH	łz)			C _{obo}	- 1.8 V 81 -	3.0	pF

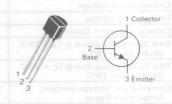
Rating	Symbol	PBF493R,RS	Unit
Collector-Emitter Voltage	VCEO	300	Vdc
Collector-Base Voltage	Vсво	300	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current - Continuous	IC	500	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5 12	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

PBF259R PBF259RS

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

NPN SILICON

Refer to MPSA92 for graphs.

	ELECTRICAL	CHARACT	TERISTICS	(TA	=	25°C unless	otherwise	noted.)	
ſ							1170.00	V 1 000111	۰

CI	naracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS						arteriste at 15	10 AND 2010
Collector-Emitter Breakdown Voltage (I _C = 3.0 mAdc, I _B = 0)	(1) Ogorne) ^V			V(BR)CEO	300	nitter Breakt	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	Visanceo			V(BR)CBO	300	use Breakdok	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	оваляејУ			V(BR)EBO	5.0	dwotweets a	Vdc
Collector Cutoff Current (V _{CB} = 250 Vdc, I _E = 0)	cao			СВО	- 10	50	nAdc
Emitter Cutoff Current (VEB = 3.0 V)	oasi			IEBO	-	20	nAdc
Collector Cutoff Current (VCE = 10 V)	035			ICEO		50	nAdc
ON CHARACTERISTICS (1)					13	Leavenus va	A CONTRACTOR
DC Current Gain	344	PBF259RS All Types All Types	PBF2898 All Types	hFE	60 25 25	usin_ mAda_Vgg = mAda_Vgg V	
Collector-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 1.5 mAdc) (I _C = 30 mAdc, I _B = 60 mAdc)	VOEIsed			VCE(sat)	egetioV noitage 5. mAde)	0.5 1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mA, I _B = 2.0 mA)				V _{BE(sat)}	som anan	0.9	NS TANK
SMALL-SIGNAL CHARACTERISTICS	. 71			SARR AR	Product	ABDINDMES I	ASIC TRIGHTED
Current-Gain Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f =	20 MHz)			fT	40	ecitanos	MHz
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MH	łz)	L		C _{obo}		3.0	pF

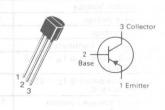
Rating	Symbol	PBF493, S	Unit
Collector-Emitter Voltage	VCEO	300	Vdc
Collector-Base Voltage	VCBO	300	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current - Continuous	IC	55A 500	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.5	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C -

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _H JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

PBF493 PBF493S

CASE 29-04, STYLE 1 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

PNP SILICON

Refer to MPSA92 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.), yearloo gooloo 0.75 or at 1 2017 804370 ARAM 2 14.2

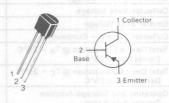
rintl xaM ntM Ch	aracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS			•			SOMETHIS IN	ez .
Collector-Emitter Breakdown Voltage ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	(1)			V(BR)CEO	300	byland o (pri el Le el proésio	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_E = 0)$	V(BRICBO			V(BR)CBO	300	volsk ji i 2.0 s oku. 1g = 0	Vdc.
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	089(RS) Y			V(BR)EBO	5.0	mwab as ana 11	Vdc
Collector Cutoff Current (V _{CB} = 200 Vdc, I _E = 0)	060)			ICBO	- 10	0.25	μAdc
Emitter Cutoff Current (VEB = 3.0 V)	003			IEBO	_	20	nAdc
Collector Cutoff Current (VCE = 10 V)	090)			ICEO	_	250	nAdc
ON CHARACTERISTICS (1)					(1)	I CONTENED OF	SHALL IN
DC Current Gain	344	PBF493S All Types All Types	PEF492RS All Types All Types	hFE	40 40 25	30	— — — — — — — — — — — — — — — — — — —
$ \begin{array}{ll} \mbox{Collector-Emitter Saturation Voltage} \\ \mbox{(I}_{\mbox{\scriptsize C}} = 20 \mbox{ mAdc, I}_{\mbox{\scriptsize B}} = 2.0 \mbox{ mAdc)} \end{array} $	VCE(sat)			V _{CE(sat)}	epshov no 0 mate)	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	realB8V			V _{BE(sat)}	Special Option 0	no 0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS					ROTERRAT	JNAL CHARAC	991. A 65
Current-Gain Bandwidth Product (IC = 10 mAdc, VCE = 20 Vdc, f =	20 MHz)			fT (sHM us	50	entiwened of	MHz
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MH	(z)			C _{obo}	E/10 1 = 1 :	6.0	pF

Rating	Symbol	PBF259R,RS	Unit
Collector-Emitter Voltage	VCEO	300	Vdc
Collector-Base Voltage	Vсво	300	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current - Continuous	IC	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	M#V1.5	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C -

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RHJC	200	°C/W

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



HIGH VOLTAGE TRANSISTORS

PNP SILICON

Refer to MPSA42 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) The second DRS = ATI 2011 21821 DARAMO JACKSTOSLE

sinU xatW niM Ch	aracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS						CTEMBTICS	A HAHO TRO
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	(1))33(RS)V			V _(BR) CEO		nitter <u>B</u> repicd mAdo, [g] =	
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	Viseicao			V(BR)CBO	300	ise El <u>ma</u> kdow LAde, 1g = 0	
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	V(вя)кво			V _{(BR)EBO}	5.0	a Bre <u>ak</u> down a Ado, Tg =	
Collector Cutoff Current (V _{CB} = 200 Vdc, I _E = 0)	080			ICBO	- (0	0.25	
Emitter Cutoff Current (VEB = 3.0 V)	083			IEBO	-	20	nAdc
Collector Cutoff Current (VCE = 10 V)	0301			ICEO	-	250	nAdc
ON CHARACTERISTICS (1)					(*	OTERISTICS (MEARS MC
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 30 mAdc, V _{CE} = 10 Vdc)	398	PBF493RS All Types All Types	REFASS All Types All Types	hFE	40 40 25	inxe∂ apV=abAm apV=acAm apAdd=Am	RC = 0.1
Collector-Emitter Saturation Voltage ($I_C = 20 \text{ mAdc}$, $I_B = 2.0 \text{ mAdc}$)	VCE(sar)			V _{CE(sat)}		0.5	
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	(sa)58 ^V			V _{BE(sat)}		0.9 8 e. mAde, lg p	
SMALL-SIGNAL CHARACTERISTICS					20172193TC	NAL CHARAC	DIE-TTVRI
Current-Gain Bandwidth Product (IC = 10 mAdc, VCE = 20 Vdc, f =	20 MHz)			fT se tems		n Bandwiden nAdc Ves v	
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 MH	odo [©]			Cobo	HW 0.1 = 1.0	6.0 attso	reD tpFte0

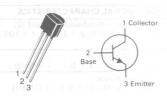
				23/14/12/14
Rating 8.0	Symbol	P2N 2222	P2N 2222A	Unit
Collector-Emitter Voltage	VCEO	30	40	Vdc
Collector-Base Voltage	VCBO	60	75	Vdc
Emitter-Base Voltage	VEBO	5.0	6.0	Vdc
Collector Current - Continuous	IC	6	00	mAdc
Total Device Dissipation TA = 25°C Derate above 25°C	odo PD		25	mW mW/°C
Total Device Dissipation T _C = 25°C Derate above 25°C	od. PD		.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55 t	+150	23218C4

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RiJC	83.3	°C/W
Thermal Resistance, Junction to Ambient	RiJA	200	°C/W

P2N2222 P2N2222A

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

NPN SILICON

Refer to MPS2222 for graphs.

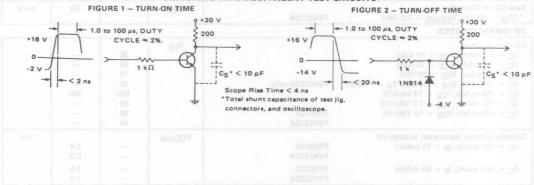
ELECTRICAL CHARACTERISTICS (TA	= 25°C ι	inless otherwise noted.)	(sH)(.0), (1 350 00 =	BOX FRANCE	
Chara	cteristic	42372M24	Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage		PZNZZZZA	V(BR)CEO	1.00 Vdc, 1	894 V.A	Vdc
(I _C = 10 mAdc, I _B = 0)	oD'da	P2N2222 P2N2222A A3333M39	(xHM 8.18 =	30	Der - bra	14
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)		P2N2222 ASSSSMS9 P2N2222A	V(BR)CBO	60 75	HIT = 311H	Vdc
		PZNZZZZA WIE		831/3 891	DARAMO-4	
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		P2N2222 1 amigrāj japām ē P2N2222A	V(BR)EBO	5.0 6.0	=	Vdc
Collector Cutoff Current (VCE = 60 Vdc, VEB(off) = 3.0 Vdc)	13	P2N2222A IS STUDY	ICEX	(8) 781	10	nAdc
Collector Cutoff Current (VCB = 50 Vdc, IE = 0) (VCB = 60 Vdc, IE = 0) (VCB = 50 Vdc, IE = 0, TA = 150°C) (VCB = 60 Vdc, IE = 0, TA = 150°C)	superi si	P2N2222 P2N2222A P2N2222 P2N2222	ІСВО	= = 91 00E = 91	0.01 0.01 10 10	μAdo
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)		P2N2222A	IEBO	-	10	nAdd
Collector Cutoff Current (V _{CE} = 10 V)	munain	G TIME EQUIVALENT TEST	ICEO	_	10	nAdc
Base Cutoff Current (VCE = 60 Vdc, VEB(off) = 3.0 Vdc)		P2N2222A	IBEX	BUT -+ 38U	20	nAdc
ON CHARACTERISTICS	TOID THE		oc 2 vri	10 100 µ4, 04	Q	
DC Current Gain (IC = 0.1 mAdc, VCE = 10 Vdc) (IC = 1.0 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc) (IC = 150 mAdc, VCE = 10 Vdc) (IC = 150 mAdc, VCE = 10 Vdc) (IC = 500 mAdc, VCE = 10 Vdc)		P2N2222A only P2N2222 P2N2222A	hFE	35 50 75 35 100 50 30 40	300	
Collector-Emitter Saturation Voltage (1) (I _C = 150 mAdc, I _B = 15 mAdc)		P2N2222 P2N2222A	VCE(sat)	_	0.4 0.3	Vdc
($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)		P2N2222 P2N2222A		_	1.6 1.0	

ELECTRICAL CHARACTERISTICS (continued) (TA = 25 °C unless otherwise noted.)

AT THE WAY AND ARROWS IN BY	Characteristic			Symbol	Min	Max	Unit
Base-Emitter Saturation Vol (IC = 150 mAdc, IB = 15		P2N2222 P2N2222A	nsa	VBE(sat)	— 0.6	1.3	Vdc
(IC = 500 mAdc, IB = 50)	mAdc)	P2N2222 P2N2222A		VCEO	=	2.6	nit mbett
SMALL-SIGNAL CHARACT	ERISTICS	Jby dv	08	083V		ogerluv o	Dactor Bas
Current-Gain - Bandwidth I (IC = 20 mAdc, VCE = 20		P2N2222 P2N2222A	0.5	.083. _t I	250 300	Voltage ent — Cons	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f =	= 1.0 MHz)	3º Wm 3	18	C _{obo}	00 A	8.0	pF
Input Capacitance (VEB = 0.5 Vdc, IC = 0, f	= 1.0 MHz)	P2N2222 P2N2222A	of ed	Cipo	in section	30 25	pF pF
Input Impedance (IC = 1.0 mAdc, VCE = 10 (IC = 10 mAdc, VCE = 10		P2N2222A P2N2222A	Ma	hie	2.0 0.25	8.0 1.25	kΩ
Voltage Feedback Ratio (IC = 1.0 mAdc, VCE = 10 (IC = 10 mAdc, VCE = 10		P2N2222A P2N2222A	ea 05	Augh Ide	han to Gas on t <u>o A</u> mb	8.0 4.0	X10 ⁻⁴
Small-Signal Current Gain (IC = 1.0 mAdc, VCE = 10 (IC = 10 mAdc, VCE = 10) Vdc, f = 1.0 kHz)	P2N2222A P2N2222A	iyrerba z	hfe	50 75	300 375	AO RTOS
Output Admittance (IC = 1.0 mAdc, VCE = 10 (IC = 10 mAdc, VCE = 10		P2N2222A P2N2222A		hoe	5.0 25	35 200	μmhos
Collector Base Time Consta (IE = 20 mAdc, VCB = 20		P2N2222A	N2222 N2222A			150	ps of
Noise Figure (I _C = 100 μAd VCE = 10 Vdc, R _S = 1.0 k		P2N2222A	25.26%	NF	Vellage	(0 4.0 p)	dB
SWITCHING CHARACTERI	STICS MPS2222A on	ly	N22220M				
Delay Time (V	CC = 30 Vdc, VBE(off)	= 0.5 Vdc,		td	-60 6 Ho	10	ns
	= 150 mAdc, IB1 = 1			tr		25	ns
Storage Time	(Vcc = 30 Vd	c, Ic = 150 mAdc,		ts		225	ns
Fall Time IB	$I = I_{B2} = 15 \text{ mAdc}$ (F			tf	LANGETT B	60	ns

(2) fT is defined as the frequency at which Ihfel extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS



IVIAXIIVIOIVI NAI IIVGS				
Rating	Symbol	P2N P2N 2907 2907A	Unit	
Collector-Emitter Voltage	VCEO	40 60	Vdc	
Collector-Base Voltage	Vсво	60	Vdc	
Emitter-Base Voltage	VEBO	5.0	Vdc	
Collector Current - Continuous	IC	600	mAdc	
Total Device Dissipation T _A = 25°C Derate above 25°C	PD PD	625 5.0	mW/°C	
Total Device Dissipation T _C = 25°C Derate above 25°C	PD	1.5 12	Watts mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C	

THERMAL CHARACTERISTICS

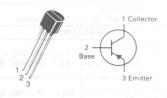
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R ₀ JC	83.3	°C/W
Thermal Resistance, Junction to Ambient	R _ð JA	200	°C/W

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic

P2N2907 P2N2907A

CASE 29-04, STYLE 17 TO-92 (TO-226AA)



AMPLIFIER TRANSISTORS

PNP SILICON

Min

Symbol

Refer to MPS2907 for graphs.

Max

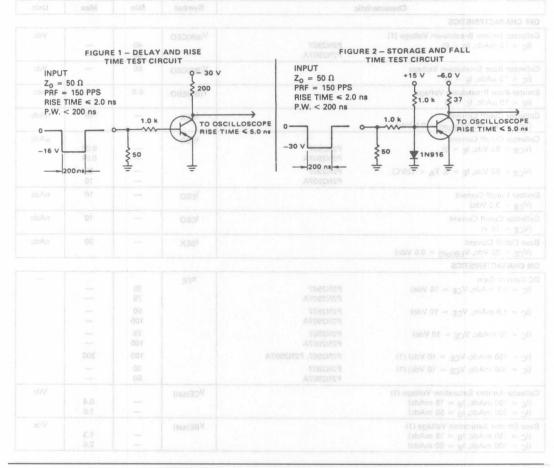
Unit

Collector-Emitter Breakdown Voltage (1) (IC = 10 mAdc, IB = 0)	P2N2907 P2N2907A		V(BR)CEO	40 60	150 0 <u>15</u>	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_E = 0)$	INPUT Zo + 90 IR	V	V(BR)CBO	60	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	PRE TROPPS RISE TAKE < 2.0		V _{(BR)EBO}	5.0	89 4 087 1000 × 330	Vdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{EB(off)} = 0.5 Vdc)	F3	4	ICEX	H C F	50	nAdc
Collector Cutoff Current $(V_{CB} = 50 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 50 \text{ Vdc}, I_E = 0, T_A = 125^{\circ}\text{C})$	P2N2907 P2N2907A P2N2907 P2N2907		СВО		0.02 0.01 20 10	μAdc
Emitter Cutoff Current (V _{EB} = 3.0 Vdc)			IEBO	_	10	nAdc
Collector Cutoff Current (V _{CE} = 10 V)			ICEO	_	10	nAdc
Base Cutoff Current (V _{CE} = 30 Vdc, V _{EB(off)} = 0.5 Vdc)			IBEX	_	50	nAdc
ON CHARACTERISTICS						
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 10 Vdc)	P2N2907 P2N2907A		hFE	35 75	_	-

	P2N2907A		75	_	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	P2N2907 P2N2907A		50 100	_	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	P2N2907 P2N2907A		75 100	_	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) (1)$	P2N2907, P2N2907A		100	300	
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) (1)$	P2N2907 P2N2907A		30 50	_	
Collector-Emitter Saturation Voltage (1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)		VCE(sat)	_	0.4 1.6	Vdc
Base-Emitter Saturation Voltage (1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)		VBE(sat)	_	1.3 2.6	Vdc

ELECTRICAL CHARACTERISTICS (continued) (TA = 25 °C unless otherwise noted.)

Characteristic	Characteristic		Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS					EDISTIN S	ATTRIBUTE
Current-Gain - Bandwidth Product (1), (2) (IC = 50 mAdc, VCE = 20 Vdc, f = 100 MHz)	rinU	P2N P2N	odmytT	200	Rating	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz)	Vac	00 04	Cobo		8.0	pF
Input Capacitance (VBE = 2.0 Vdc, IC = 0, f = 1.0 MHz)	abV	0.8	Cibo	_	930 oV	pF
SWITCHING CHARACTERISTICS	DERM	000	al le	auguni	med - trient	uD rotos
Turn-On Time	Wm	828	19ton	TA- 264	50	ns
Delay Time (VCC = 30 Vdc, IC = IB1 = 15 mAdc) (Figu			t _d		10	ns
Rise Rime	ires railu 5)		t _r	167 ± 31	40	ns
Turn-Off Time	730	-ss to + 150	toff		110	ns
	(VCC = 6.0 Vdc, IC = 150 mAdc, IB1 = IB2 = 15 mAdc) (Figure 2)		ts	_	80	ns
Fall Time			tf	1STI CS	30	I ns

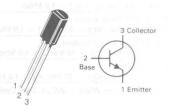


Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	80	Vdc
Collector-Base Voltage	VCBO	120	Vdc
Emitter-Base Voltage	VEBO	7.0	Vdc
Collector Current - Continuous	IC	1.0	Adc
Total Device Dissipation T _A = 25°C Derate above 25°C	PD PD	1.0 8.0	Watts mW/°C
Total Device Dissipation T _C = 25°C Derate above 25°C	PD	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RoJC	50	°C/W
Thermal Resistance, Junction to Ambient	ROJA	125	°C/W

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



ONE WATT AMPLIFIER TRANSISTORS

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			pi de c	
Collector-Emitter Breakdown Voltage (1) (IC = 30 mAdc, I _B = 0)	V(BR)CEO	80		Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	V(BR)CBO	120		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)	V(BR)EBO	7.0		Vdc
Collector Cutoff Current $(V_{CB} = 90 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 90 \text{ Vdc}, I_{E} = 0, T_{A} = +150^{\circ}\text{C})$	Office ICBO ACT	HTM03 ⁻³⁴	0.01 10	μAdc
Emitter Cutoff Current (VBF = 5.0 Vdc, IC = 0)	IEBO	_	0.01	μAdc

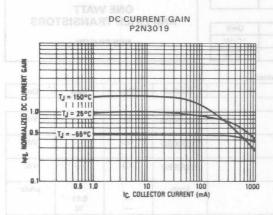
ON CHARACTERISTICS

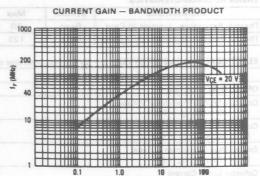
ON CHARACTERISTICS					
DC Current Gain (1) (IC = 0.1 mAdc, V _{CE} = 10 Vdc) (IC = 10 mAdc, V _{CE} = 10 Vdc) (IC = 150 mAdc, V _{CE} = 10 Vdc) (IC = 150 mAdc, V _{CE} = 10 Vdc, T _C = -55°C) (IC = 500 mAdc, V _{CE} = 10 Vdc) (IC = 1.0 Adc, V _{CE} = 10 Vdc)	P2N3019 P2N3019 P2N3019 P2N3019 P2N3019	hFE	50 90 100 40 50	300	
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	10 3	VCE(sat)		0.2 0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)		V _{BE} (sat)		1.1	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	P2N3019	f _T	80		MHz

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

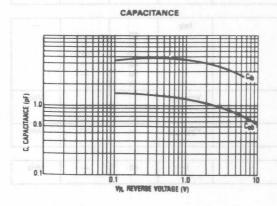
Characteristic			Symbol	Min	Max	Unit
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)			C _{obo}	-	12	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	zinti	sutav	Cibo	_	60	pF
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	P2N3019	120	h _{fe}	80	400	Collector-B
Collector Base Time Constant (I _E = 10 mAdc, V _{CB} = 10 Vdc, f = 4.0 MHz)	P2N3019	6.7	rb'C _c	second	400	ps
Noise Figure $(I_C = 100 \mu\text{Adc}, V_{CF} = 10 \text{Vdc}, R_S = 1.0 \text{kohm})$	ns, f = 1.0 kHz)	0.8	MF O	TA = 25	4.0 ± 0.0	dB

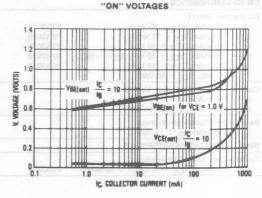
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.0%.



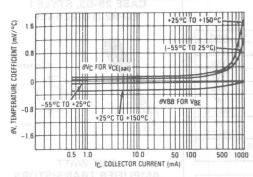


IC. COLLECTOR CURRENT (M.A.B.C.)

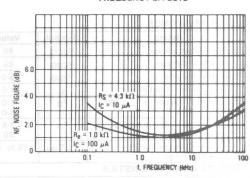




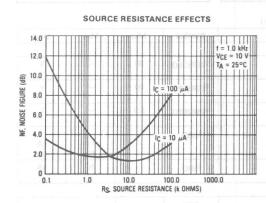


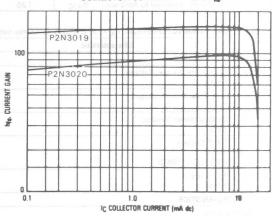


FREQUENCY EFFECTS



CURRENT GAIN BANDWIDTH PRODUCT versus COLLECTOR CURRENT — 1 MHz hije





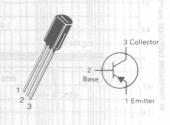
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	80	Vdc
Collector-Base Voltage	VCBO	80	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current - Continuous	Ic	1.0	Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1.0 8.0	W mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 20	w mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	ReJC	50	°C/W
Thermal Resistance, Junction to Ambient	RHJC	125	°C/W

P2N4033

CASE 29-03, STYLE 1 TO-92 (TO-226AE)



ONE WATT AMPLIFIER TRANSISTORS

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	18001=1 11 11			
Collector-Emitter Breakdown Voltage (IC = 10 mA)	V(BR)CEO	80		V
Collector-Base Breakdown Voltage (IC = 10 μ A)	V(BR)CBO	80		V 9.8
Emitter-Base Breakdown Voltage (I _E = 10 μA)	V(BR)EBO	5.0		V
Collector Cutoff Current (V _{CB} = 60 V) (V _{CB} = 60 V, T _A = 150°C)	СВО		5.0 50	nA μA
Emitter Cutoff Current (VEB = 5.0 V)	lebo		10	nA

ON CHARACTERISTICS

DC Current Gain		hFE			_
$(I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V}, -55^{\circ}\text{C})$	P2N4033		40	_	
$(I_C = 100 \mu\text{A}, V_{CF} = 5.0 \text{V})$	P2N4033		75	_	
$(I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V})$	P2N4033		100	300	
$(I_C = 500 \text{ mA}, V_{CF} = 5.0 \text{ V})$	P2N4033		70	_	
$(I_C = 1.0 \text{ A}, V_{CE} = 5.0 \text{ V})$	P2N4033		25		
Collector-Emitter Saturation Voltage		V _{CE(sat)}			V
$(I_C = 150 \text{ mA}, I_B = 15 \text{ mA})$		02(001)	_	0.15	
$(I_C = 500 \text{ mA}, I_B = 50 \text{ mA})$			_	0.5	
Base-Emitter Saturation Voltage		V _{BE} (sat)			V
$(I_C = 150 \text{ mA}, I_B = 15 \text{ mA})$				0.9	
$(I_C = 500 \text{ mA}, I_B = 50 \text{ mA})$			_	1.1	

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Output Capacitance (VCE = 10 V, f = 1.0 MHz)	C _{obo}		25	pF
Input Capacitance (VEB = 0.5 V, f = 1.0 MHz)	Cibo		150	pF
Current Gain — Bandwidth Product (I _C = 50 mA, V _{CC} = 10 V, f = 100 MHz)	f _T	150		MHz
SWITCHING CHARACTERISTICS			-	
Turn-On Time (see Figure 1) (I _C = 500 mA, I _{B1} = 50 mA)	ton		100	ns
Turn-Off Time (see Figure 1) (I _C = 500 mA, I _{B1} = I _{B2} = 50 mA)	toff		400	ns

⁽¹⁾ Pulse Width = 300 μs, Duty Cycle 1.0%.

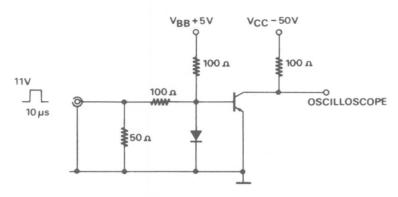
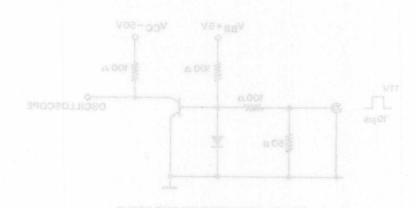
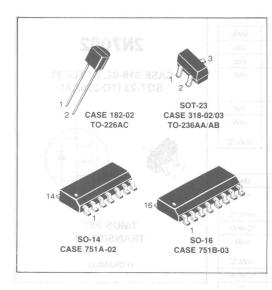


FIGURE 1: SWITCHING TIMES TEST CIRCUIT

FI FOT SIGAL CHARACTERISTICS continued if a 2000 orders otherwise noted.)

AND Color Dated on MAC - 4th Acres 1841 to





A wide variety of discrete components from Motorola's repertoire of reliability-proven semiconductor processes and geometries are available in the SOT-23, SO-14 and SO-16 packages. Products include Bipolar and Field-Effect Transistors, Diode Arrays, Switching Diodes, Zener and Varactor Diodes.

Contact your Motorola representative for ordering information. The Product Portfolio is constantly being expanded to meet the requirements for surface mount technology.

Tape and Reel is available for high volume, automated processing.

Contact the Motorola sales representative if there is a requirement for product that is not represented in this publication.

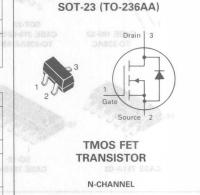
Surface Mount Products

3

		י טטח		1 440
Drain Current — Continuous — Pulsed(2)	$T_{C} = 25^{\circ}C(1)$ $T_{C} = 100^{\circ}C(1)$	I _D I _D	± 115 ± 75 ± 800	mA
Gate-Source Voltage		VGS	± 40	Vdc
Total Power Dissipation Derate above 25°C ambient	$T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$	PD	200 80 0.16	mW mW/°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	R_{θ} JA	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C



package .. Products include Bipplar and Field Effect Tran

tors. Diode Arrays, Switching Diodos, Zener and Varactor

CASE 318-02, STYLE 21

DEVICE MARKING

2N7002 = 702

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	helematus are	vgotonnoer	muum sasm	aneurs for su	Property Compa
Drain-Source Breakdown Voltage (VGS = 0, ID = 10 μ A)	V(BR)DSS	60	enten aolse	. – Ire Motorola	Vdc
Zero Gate Voltage Drain Current (VGS = 0, VDS = 60 V) $T_J = 25^{\circ}C$ $T_J = 125^{\circ}C$	IDSS	eirli ni beini	not represe	1.0 500	μAdc
Gate-Body Leakage Current Forward (VGS = 20 Vdc)	IGSSF	_	-	100	nAdc
Gate-Body Leakage Current Reverse (VGS = -20 Vdc)	IGSSR	_	-	- 100	nAdc

⁽¹⁾ The Power Dissipation of the package may result in a lower continuous drain current.

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

⁽²⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Characteristic			Symbol	Min	Тур	Max	Unit
ON CHARACTERISTICS*	V	0.0	0.6	Oagy		oner or	
Gate Threshold Voltage $(V_{DS} = V_{GS}, I_D = 250 \mu A)$	SIJAM	orie	VGS(th)	1.0	Puritings).	2.5	Vdc
On-State Drain Current $(V_{DS} \ge 2.0 V_{DS(on)}, V_{GS} = 10 V)$			ID(on)	500	21 <u>2415</u> 005 	APA <u>F</u> 9 .o. iand5	mA
Static Drain-Source On-State Voltage (V _{GS} = 10 V, I _D = 500 mA) (V _{GS} = 5.0 V, I _D = 50 mA)	Wm.	225	V _{DS(on)}		50E (1911-16)	3.75	Vdc
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	Wm(3) Wm 3/4Wm	566 300 2.4	rDS(on)	Inside	Est to long	7.5 13.5 7.5 13.5	Ohms
Forward Transconductance (V _{DS} ≥ 2.0 V _{DS(on)} , I _D = 200 mA)	D, MWD	150	9FS	80		Description of	mmhos
DYNAMIC CHARACTERISTICS					(n) Latin	7000	
Input Capacitance AAR 9A9 (VDS = 25 V, VGS = 0, f = 1.0 MHz)			C _{iss}	ARRUE PERS	1. 181 SAL O K	50	pF
Output Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)		(38 =	Coss	- 0A_5878	38 <u>2 100</u> 34 7 98 8	25	pF
Reverse Transfer Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MHz)		(Joston naiw)	Crss	es – An Si	ACTERISTS	5.0	pF
SWITCHING CHARACTERISTICS*	1000mys			3030000	Char		
Turn-On Delay Time $(V_{DD} = 30 \text{ V}, I_{D} \approx 20 \text{ V})$	0 mA,		t _{d(on)}		80	20	ns
Turn-Off Delay Time $R_G = 25 \Omega$, $R_L = 150$	V(BR)CE(Q)		td(off)	eb	DON DAMES S	20	ns
BODY-DRAIN DIODE RATINGS			BCB05 Sanes				
Diode Forward On-Voltage (I _S = 11.5 mA, V _{GS} = 0 V)	VIGRICES		V _{SD}	= 913	dov – otals	- 1.5	V
Source Current Continuous (Body Diode)	OSHABIV		IS 80808		opaniuV nivo	- 115	mA
Source Current Pulsed			ISM	_	_	- 800	mA

^{*}Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

MAXIMOM HATHEGO				
Rating	Symbol	BC807	BC808	Unit
Collector-Emitter Voltage	VCEO	45	25	V
Collector-Base Voltage	VCBO	50	30	V
Emitter-Base Voltage	VEBO	5.0	5.0	V
Collector Current — Continuous	lc	500	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300 2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BC807-16 = 5A; BC807-25 = 5B; BC807-40 = 5C; BC808-16 = 5E;

BC808-25 = 5F; BC808-40 = 5G

BC807 BC808

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE
TRANSISTOR

PNP SILICON

ELECTRICAL	CHARACTERISTICS	(TA	=	25°C	unless	otherwise	noted.)	

Characterist	ic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						0
Collector-Emitter Breakdown Voltage	BC807 Series BC808 Series	V(BR)CEO	45 25	= <u>a</u> R = annan	Daugy Time RAIN CIOSE	
Collector-Emitter Breakdown Voltage (V _{EB} = 0)	BC807 Series BC808 Series	V(BR)CES	50 30		V-n0 have	= 211
Am Bit — — —	BC000 Series		30	Shorio	Supply Trients	Saurce
Emitter-Base Breakdown Voltage	BC807 Series BC808 Series	V(BR)EBO	5.0 5.0	_ b	Diode) Orrent Pulsi	VBody
Collector Cutoff Current (V _{CB} = 20 V) (V _{CB} = 20 V, T _J = 150°C)		ІСВО	- 1		100 5.0	nA μA
ON CHARACTERISTICS						
DC Current Gain (IC = 100 mA, VCE = 1.0 V) $(I_C = 500 \text{ mA}, V_{CE} = 1.0 \text{ V})$	BC807-16 BC808-16 BC807-25 BC808-25 BC807-40 BC808-40	hFE hfe	100 160 250 40	-	250 400 600	
Collector-Emitter Saturation Voltage (I _C = 500 mA, I _B = 50 mA)		VCE(sat)			0.7	V
Base-Emitter On Voltage (I _C = 500 mA, I _B = 1.0 V)		VBE(on)	-		1.2	V
SMALL-SIGNAL CHARACTERISTICS					39	
Current-Gain Bandwidth Product (I _C = 10 mA, V _{CE} = 5.0 Vdc, f = 35 M	Hz)	fT	200		-	MHz
Output Capacitance (V _{CB} = 10 V, f = 1.0 MHz)		C _{obo}		10	11-	pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	BC817	BC818	Unit	
Collector-Emitter Voltage	VCEO	45	25 08	V	
Collector-Base Voltage	VCBO	50	0.8 30 0.8	V	
Emitter-Base Voltage	VEBO	5.0	5.0 00	V	
Collector Current — Continuous	IC	500	500	mAdc	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* ΤΔ = 25°C	PD	225	mW	
Derate above 25°C		1.8	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW	
Derate above 25°C		2.4	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW	
Junction and Storage Temperature	TJ, Tstq	150	°C	

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

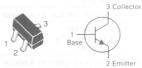
DEVICE MARKING

BC817-16 = 6A; BC817-25 = 6B; BC817-40 = 6C; BC818-16 = 6E; BC818-25 = 6F; BC818-40 = 6G

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characte	eristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	30						
Collector-Emitter Breakdown Voltage	58 58	BC817 Series BC818 Series	V(BR)CEO	45 25		_	V
Collector-Emitter Breakdown Voltage (V _{EB} = 0)	0.0	BC817 Series BC818 Series	V(BR)CES	50 30	eps_leV ()	eriodenti .	V
Emitter-Base Breakdown Voltage	5.0	BC817 Series BC818 Series	V(BR)EBO	5.0 5.0	=	95 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	V
Collector Cutoff Current (V _{CB} = 20 V) (V _{CB} = 20 V, T _A = 150°C)			ICBO	=		100 5.0	nA μA
ON CHARACTERISTICS							
DC Current Gain (IC = 100 mA, VCE = 1.0 V)		BC817-16 BC818-16 BC817-25 BC818-25 BC817-40	BH, REPAYB, B 76, BCB48C BA, BCB47A, B 98, BCB47B, B 70, BCB48C		<u>v</u> (c.e.	250 400	
$(I_C = 500 \text{ mA}, V_{CE} = 1.0 \text{ V})$		BC818-40	h _{fe}	250 40	agetin Tirkina Tiken	600	
Collector-Emitter Saturation Voltage (I _C = 500 mA, I _B = 50 mA)		unes STRIV	V _{CE} (sat)		u <u>te</u> n 18	8 0.7	V
Base-Emitter On Voltage (I _C = 500 mA, V _{CE} = 1.0 V)			V _{BE} (on)	_		1.2	V
SMALL-SIGNAL CHARACTERISTICS					SOUTS METO/	RANGUM -	S. 277
Current-Gain Bandwidth Product (I _C = 10 mA, V _{CE} = 5.0 Vdc, f = 3	35 MHz)	T [†]	fT	200	n Pr <u>odu</u> ct 5.0 Valo, 5.5		MHz
Output Capacitance (VCB = 10 V, f = 1.0 MHz)		6000	C _{obo}	-	10	South 1	pF

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	BC846	BC847	BC848	Unit
Collector-Emitter Voltage	VCEO	65	45	30	-V
Collector-Base Voltage	VCBO	80	50	30	V
Emitter-Base Voltage	VEBO	6.0	6.0	5.0	V
Collector Current — Continuous	lc	100	100	100	mAde

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	W/m 300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

DEVICE MARKING

BC846A = 1A; BC846B = 1B; BC847A = 1E; BC847B = 1F; BC847C = 1G; BC848A = 1J; BC848B = 1K; BC848C = 1L

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

BC846A,B BC847A,B,C BC848A,B,C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to BC546 for graphs.

Characte	eristic		:38	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						130 = 00-0		
Collector-Emitter Breakdown Voltage	DCCA	CAR	(beron salw	V(BR)CEO	65	CTERISTIC	CAL CHAR	V
	BC84	7A,B,C				Chara		
		8A,B,C			30	- 20	HT2875TDAR	
Collector-Emitter Breakdown Voltage			1 77	V(BR)CES		kdown Veltar		V
$(V_{EB} = 0)$		6A,B		sans2 Tra	80		101111	
		7A,B,C			50 30	_	_	
	BC84	8A,B,C			30	estav avopa	anis regions	V
Emitter-Base Breakdown Voltage	BC84			V(BR)EBO	6.0	_		V
	BC84				6.0		_	
	BC84	8A,B,C			5.0	nestrov m	ese Sreekdey	C-rettim
Collector Cutoff Current		943/195		ІСВО	18			
$(V_{CB} = 30 \text{ V})$					18 —	_	15	nA
$(V_{CB} = 30 \text{ V}, T_A = 150^{\circ}\text{C})$		cara			_	- 1	5.0	μΑ
ON CHARACTERISTICS								
DC Current Gain				hFE		10.009	E-AT V DE	80 A.
$(I_C = 10 \mu A, V_{CE} = 5.0 V)$	BC84	6A, BC847A,	BC848A			90	ACTUERISTIC	P. SHO M
		6B, BC847B,	BC848B		-	150	Train I	S CHIPPE
	BC84	7C, BC848C				270	BOY Am 00	0 = 0W
(I- 20-2 V 50 V)	001	6A. BC847A.	DC040A			180	220	
$(I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V})$		6B, BC847B,				290	450	
		7C, BC848C	BC040B		420	520	800	
Collector-Emitter Saturation Voltage	250	70,000,00		24 10 200	8	020		V
(Ic = 10 mA, I _B = 0.5 mA)				VCE(sat)	_	(<u>V</u> (0,t) =	0.25	8 = 31)
(I _C = 100 mA, I _B = 5.0 mA)					-	ation Voltage	0.6	e atawité
Base-Emitter Saturation Voltage				V _{BE(sat)}		(Am 08	e gf .Am 00	V
$(I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA})$				22(300)	_	0.7	ner Orr Velta	m9-eas
$(I_C = 100 \text{ mA}, I_B = 5.0 \text{ mA})$		(IIIO)			-	0.9	33V thm 00	1 = 30
SMALL-SIGNAL CHARACTERISTICS								
Current-Gain Bandwidth Product	DOG.	TI.		fT	100		biwbr - 8 ms	MH
$(I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ Vdc}, f = 3.0 \text{ Vdc})$	55 (VIHZ)				(sittivi 8E	5,0 Vdc, f =	0 mA, VCE =	(= 31)
Output Capacitance (V _{CB} = 10 V, f = 1.0 MHz)		Cobb		C _{obo}		(±1484-0	4.5 July 01	pF.
Noise Figure (I _C = 0.2 mA, V _{CE} = 5.0 Vdc, R _S = f = 1.0 kHz, BW = 200 Hz)	= 2.0 kΩ,			NF	-	-	10	dB

THE CONTROL OF THE CO						
Rating	Symbol	BC850	BC849	Unit		
Collector-Emitter Voltage	VCEO	45	GE 30 GG	V		
Collector-Base Voltage	VCBO	50	9.8 30 9.8	V		
Emitter-Base Voltage	VEBO	6.0	001 5.0 00	V		
Collector Current — Continuous	Ic	100	100	mAdc		

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 Vm 3	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stg}	150	°C

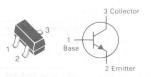
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BC849B = 2B; BC849C = 2C; BC850B = 2F; BC850C = 2G

BC849B,C BC850B,C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



LOW NOISE TRANSISTOR

NPN SILICON

Refer to BC549 for graphs.

ELECTRICAL CHARACTERISTICS (T _A = 25°C unless otherways	vise noted.)
Characteristic	

Characteri	stic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	24	Series !	8333			
Collector-Emitter Breakdown Voltage	BC850B,C BV BC849B,C	V(BR)CEO	45 30	ogazile Wakerio	estr <u>u</u> d e	V
Collector-Emitter Breakdown Voltage (VEB = 0)	0.d BC850B,C (Sh)V 0.d BC849B,C	V(BR)CES	50 30	<u> </u>	Volt L	V
Emitter-Base Breakdown Voltage	7.8	V _{(BR)EBO}	5.0			V
Collector Cutoff Current (V _{CB} = 30 V, I _E = 0) (V _{CB} = 30 V, T _A = 150°C)	080,	ІСВО	_		15 5.0	nA μA

ON CHARACTERISTICS

DC Current Gain		hFE		Children Children		7 -
$(I_C = 10 \mu A, V_{CE} = 5.0 V)$	BC849B, BC850B	A88819 A1383	2C 88iJA, DC	150	_	
	BC849C, BC850C	8578, 808588	BCBSVB, BC	270	_	
		3380	ROSEIC, BC			
$(I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V})$	BC849B, BC850B		200	290	450	
	BC849C, BC850C	ASSETA, BURSSA	98 A 420	520	800	
Collector-Emitter Saturation Voltage		V _{CE} (s	at) [8] [8]			V
$(I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA})$		2868	Dal Colored L	_	0.25	
$(I_C = 100 \text{ mA}, I_B = 5.0 \text{ mA})$			_	ENTOW WITE	0.6	
Base-Emitter Saturation Voltage	-	V _{BE(s}	at)	Lean P	a. Aliro	V
$(I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA})$		52(3	_	0.7	3 1 <u>—</u> 1	
$(I_C = 100 \text{ mA}, I_B = 5.0 \text{ mA})$			_	0.9	o her ra i	

SMALL-SIGNAL CHARACTERISTICS

Current-Gain Bandwidth Product (I _C = 10 mA, V _{CE} = 5.0 Vdc, f = 35 MHz)	fT	100			MHz
Output Capacitance (V _{CB} = 10 V, f = 1.0 MHz)	C _{obo}		→ Ole	4.5	pF
Noise Figure (I _C = 0.2 mAdc, V _{CE} = 5.0 Vdc, R _S = 2.0 k Ω , f = 1.0 kHz, BW = 200 Hz)	N _F	SHM 37	Laby De	4	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	BC856	BC857	BC858	Unit
Collector-Emitter Voltage	VCEO	65	45	30	V
Collector-Base Voltage	VCBO	80	50	30	V
Emitter-Base Voltage	VEBO	5.0	5.0	5.0	V
Collector Current — Continuous	Ic	100	100	100	mAdc

THERMAL CHARACTERISTICS 2000

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	225 statu	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

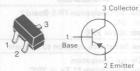
*FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

BC856A = 3A; BC856B = 3B; BC857A = 3E; BC857B = 3F; BC857C = 3G; BC858A = 3J; BC858B = 3K; BC858C = 3L

BC856A,B BC857A,B,C BC858A,B,C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to BC556 for graphs.

ELECTRICAL CHARACTERISTICS (T		d.)	F	Total Control	Service State	TOLVE
Prigray not special Character	istic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			-	ninken vote	armitistes a keeping	
Collector-Emitter Breakdown Voltage	BC856 Series BC857 Series BC858 Series	V(BR)CEO	65 45 30	Charges	ACTOMISTIC	V THE CHAR
Collector-Emitter Breakdown Voltage (VEB = 0)	BC856 Series BC857 Series BC858 Series	V(BR)CES	80 50 30			V
Emitter-Base Breakdown Voltage	BC856 Series BC857 Series BC858 Series	V(BR)EBO	5.0 5.0 5.0	Ξ		- g y /)
Collector Cutoff Current (V _{CB} = 30 V) (V _{CB} = 30 V, T _A = 150°C)	080	ІСВО	=	- 1	15 5.0	nΑ μΑ
ON CHARACTERISTICS						- Correction
DC Current Gain (I _C = 10 μ A, V _{CE} = 5.0 V) (I _C = 2.0 mA, V _{CE} = 5.0 V)	BC856A, BC857A, BC858A BC856B, BC857B, BC858B BC857C, BC858C BC856A, BC857A, BC858A BC856B, BC857B, BC858B	HFE BORGOD 149C, BCRGOD 149C, B	308 <u> </u>	90 150 270 180 290	250 475	C Curt or the control of the control
0,28	BC857C, BC858C		420	520	800	11 = 20
Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5.0 mA)		VCE(sat)	=	i Voltage 5 mA v	0.3 0.65	((v = 1) nse-Er in (fr = 7)
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$) ($I_C = 100 \text{ mA}, I_B = 5.0 \text{ mA}$)		VBE(sat)	_	0.7 0.9	BAHT IAVS	I = VI)
Base-Emitter On Voltage (I _C = 2.0 mA, V_{CE} = 5.0 V) (I _C = 10 mA, V_{CE} = 5.0 V)		V _{BE(on)}	0.6	5.0 Vdo, f =]	0.75 0.82	y sugtu
SMALL-SIGNAL CHARACTERISTICS				[21104	DOI THE TOTAL	E SOVE
Current-Gain Bandwidth Product (I _C = 10 mA, V _{CE} = 5.0 Vdc, f = 35	MHz)	f _T	100	= 8.0 Vde, R	2 mA <u>dic</u> , Veri	MHz
Output Capacitance (V _{CB} = 10 V, f = 1.0 MHz)		C _{obo}	-		4.5	pF
Noise Figure (I _C = 0.2 mA, V _{CE} = 5.0 Vdc, R _S = f = 1.0 kHz, BW = 200 Hz)	2.0 kΩ,	NF	 		10	dB

Rating	Symbol	BC860	BC859	Unit
Collector-Emitter Voltage	VCEO	45	30	V
Collector-Base Voltage	VCBO	50	30	V
Emitter-Base Voltage	VEBO	6.0	5.0	V
Collector Current — Continuous	Ic	100	100	mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
			-
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	eat ∘c

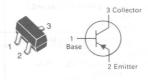
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BC859A = 4A; BC859B = 4B; BC859C = 4C; BC860A = 4E; BC860B = 4F; BC860C = 4G

BC859A,B,C BC860A,B,C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



LOW NOISE TRANSISTOR

PNP SILICON

Refer to BC559 for graphs.

Characte	ristic (,bston ser	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	Symbol		oteristic	io.		
Collector-Emitter Breakdown Voltage	BC860 Series BC859 Series	V(BR)CEO	45 30	applied two		V
Collector-Emitter Breakdown Voltage (VEB = 0)	BC860 Series BC859 Series	V(BR)CES	50 30	agusay mao	14961 1 to 14	V
Emitter-Base Breakdown Voltage	OBSHRIM	V(BR)EBO	5.0	all tallace in	x	V
Collector Cutoff Current (VCB = 30 V, I _E = 0) (VCB = 30 V, T _A = 150°C)	VIRRIERO	СВО	=	8:20 5 6 7	15 5.0	nA μA
ON CHARACTERISTICS	080					
DC Current Gain (I _C = 10 μ A, V _{CE} = 5.0 V)	BC859A, BC860A BC859B, BC860B	hFE	_	90 150	20:27 an 10	-
$(I_C = 2.0 \text{ mA, } V_{CE} = 5.0 \text{ V})^{3.7 \text{ M}}$	BC859C, BC860C BC859A, BC860A BC859B, BC860B BC859C, BC860C	9	110 200 420	270 180 290 520	220 450 800	
Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5.0 mA)	(maras) ²	VCE(sat)	_	1.b - 1.0	0.25 0.6	٧
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5.0 mA)	odu ^D	V _{BE(sat)}	=	0.7 0.9	H 2-0	V
Base-Emitter On Voltage ($I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}$) ($I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V}$)	वात	VBE(on)	0.58	gR (b <u>V</u>) 8 -	0.7 0.77	V
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain Bandwidth Product $(I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ Vdc}, f = 35)$	MHz)	fΤ	100	_	_	MHz
Output Capacitance (V _{CB} = 10 V, f = 1.0 MHz)		C _{obo}	_	_	4.5	pF
Noise Figure (I _C = 0.2 mAdc, V _{CE} = 5.0 Vdc, R _S f = 1.0 kHz, BW = 200 Hz)	= 2.0 kΩ,	NF		_	4.0	dB

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	32	Vdc
Collector-Base Voltage	VCBO	32	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	IC	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	aær °C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BCW29 = C1; BCW30 = C2

BCW29 BCW30

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

ELECTRICAL CHARACTERISTICS (T	$A = 25^{\circ}C$	unless otherwise not	ed.)	altela			
Char	acteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS		Viserceo			agefloV riwi	obkeet8 tethn	ollector En
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, I _E = 0)	45 08		Saries Series	V _(BR) CEO	32	-	Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 μ Adc, V _{EB} = 0)	08	VIBRICES	Serins	V(BR)CES	32	inter Breakde	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_C = 0)$				V _(BR) CBO	32 10 2 1 0 V	Braakdovin	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		090		V _{(BR)EBO}	5.0	memio no	Vdc
Collector Cutoff Current ($V_{CB} = 32 \text{ Vdc}, I_{E} = 0$) ($V_{CB} = 32 \text{ Vdc}, I_{E} = 0, T_{A} = 100^{\circ}\text{C}$)		nait 1		СВО		100	nAdc μAdc
ON CHARACTERISTICS	-		A08808 .	RC859A	- IVI	ed = 30V A	
DC Current Gain (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)	- 110	BCW29 BCW30	, ecseoc ecseoc	hFE	120 215	260 500	0.3 -01)
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc)	200		808808 808800	VCE(sat)	-	0.3	Vdc
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)	-	VCE(ent)		V _{BE(on)}	0.6 V	0.75	Vdc
SMALL-SIGNAL CHARACTERISTICS					0650	Old Birthin	00
Output Capacitance (I _E = 0, V _{CE} = 10 Vdc, f = 1.0 MHz)	-	(Nes)38V		C _{obo}		2.0 7.0 Am	pF _D
Noise Figure (I _C = 0.2 mAdc, V_{CE} = 5.0 Vdc, R _S = BW = 200 Hz)	= 2.0 kΩ, f	= 1.0 kHz,		NF	(V 0	On VCE = 1	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	0 150	√er °C

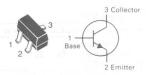
*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BCW31 = D1; BCW33 = D3

BCW31

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

	Symbol	Min	Max	Unit		
OFF CHARACTERISTICS	OFF CHARACTERISTICS OF CHARACTERISTICS			egettism never	buend's pro-	-
Collector-Emitter Breakdown Voltag (I _C = 2.0 mAdc, I _B = 0)	ge		V _(BR) CEO	20	and a co	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_B = 0$)	lces		V(BR)CBO	30	1 2 1 18 h	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)			V _{(BR)EBO}	5.0	- 3try -	Vdc
ON CHARACTERISTICS	083				1177	
DC Current Gain (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)		BCW31 BCW33	hFE	110 420	220	14-7-7-3
Collector-Emitter Saturation Voltag (I _C = 10 mAdc, I _B = 0.5 mAdc)	e gard	BCW33 BCW368	V _{CE(sat)}	(10)20 0 2	0.25	Vdc
Base-Emitter On Voltage (IC = 2.0 mAdc, VCE = 5.0 Vdc)		309M58 308M58	V _{BE} (on)	0.55	0.70	Vdc
SMALL-SIGNAL CHARACTERISTIC	S	BCW80A				
Output Capacitance (IE = 0, VCB = 10 Vdc, f = 1.0 M	ИНz)	SCW668 SCW60C	C _{obo}	_	4.0	pF
Noise Figure (I _C = 0.2 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz, BW = 200 Hz)	$R_S = 2.0 \text{ k}\Omega$,	BCW60A BCW60B	NF	106701	10	dB
90 		DCW60C BCW60D				

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

MAXIMUM NATINGS			S 0.0
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	32	V
Collector-Base Voltage	VCBO	32	V
Emitter-Base Voltage	VEBO	5.0	V
Collector Current — Continuous	lc	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

*FR-5 = 1.0 x 0.75 x 0.62 in.

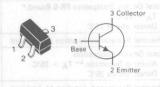
**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

BCW60A = AA; BCW60B = AB; BCW60C = AC; BCW60D = AD

BCW60A,B,C,D

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherw	vise noted.)	erer to IVIPS	3904 for grap
Characteristic	Symbol Symbol	Min	Max
OFF CHARACTERISTICS	Characteristic		
Collector-Emitter Breakdown Voltage	V(BR)CEO	32	CONTRIBATION

OFF CHARACTERISTICS	
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, I _E = 0)	V _(BR) CEO 32 Vdc
Emitter-Base Breakdown Voltage (I _E = 1.0 μ Adc, I _C = 0)	V(BR)EBO 5.0 0 sl_lahAm Vdc
Collector Cutoff Current (VCE = 32 Vdc) (VCE = 32 Vdc, TA = 150°C)	ICES 20 πAdo
Emitter Cutoff Current (VFB = 4.0 Vdc, I _C = 0)	IEBO — 20 nAdo

(- ED	1.0 100, 10		
ON CHAR	ACTERISTICS	340	183

ON CHAR	ACTERISTICS							
DC Currer	nt Gain	420		ESW3B	hFE			_
(I _C) = 1	0 μAdc, V _{CE} =	= 5.0 Vdc)		BCW60A BCW60B		30	natio r S atural mode s (§ = (
				BCW60C BCW60D		100	n On Voltage mAde, Vot	
$(I_C = 2)$	0 mAdc, VCF	= 5.0 Vdc)		BCW60A		120	220	MALL-SIG
	4.0			BCW60B BCW60C BCW60D	(s)	175 250 380	310 460 630	is tuqtu Ng = 0.1
Bb	01	-			0400		ę.	olse Figu
(IC = 5	0 mAdc, V _{CE}	= 1.0 Vdc)		BCW60A BCW60B	All that H		mAde_Vote - 120 Hz, BW_ = 200	
				BCW60C BCW60D		90 100	=	
AC Currer	nt Gain 0 mAdc, V _{CE}	= 5.0 Vdc, f	= 1.0 kHz)	BCW60A BCW60B BCW60C BCW60D	h _{fe}	125 175 250 350	250 350 500 700	_
$(I_C = 5)$	Emitter Satura 0 mAdc, I _B = 0 mAdc, I _B =	1.25 mAdc)			VCE(sat)	=	0.55 0.35	Vdc
$(I_{C} = 5)$	tter Saturation 0 mAdc, I _B = 0 mAdc, I _B =	1.25 mAdc)			V _{BE} (sat)	0.7 0.6	1.05 0.85	Vdc
	tter On Voltag .0 mAdc, V _{CE}				V _{BE} (on)	0.6	0.75	Vdc

Characteristic			Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS	histori	007		10(8/10)	tyrical and a second	
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 MHz)			f _T	125	E IDOUNE	MHz
Output Capacitance $(V_{CE} = 10 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$	Unit	Wax	C _{obo}		4.5	pF
Noise Figure (I _C = 0.2 mAdc, V_{CE} = 5.0 Vdc, R_{S} = 2.0 k Ω , f = 1.0 kHz, BW = 200 Hz)	DAWar.	8.1	NF	511165	6.0	dB
SWITCHING CHARACTERISTICS	VVIII.	907	ALIP	NEW OF THE MOS		
Turn-On Time (I _C = 10 mAdc, I _{B1} = 1.0 mAdc)	O'What	300 2.4	ton	21 TC - 6	150	ns
Turn-Off Time (I _{B2} = 1.0 mAdc, V _{BB} = 3.6 Vdc, R ₁ = R ₂ = 5.0 k Ω	WmiO'		toff	nijaš <u>i</u> jedi	800	ns
$R_1 = 990 \ \Omega$	0"		10 m2 T - 1, T	ether all t	Togal III	

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	32	V
Collector-Base Voltage	VCBO	32	remarka VIII
Emitter-Base Voltage	VEBO	5.0	V
Collector Current — Continuous	IC	100	mAdd

THERMAL CHARACTERISTICS

THE THINK OF A TANK OF EMOTION	001 20 110 200100			
Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$ Derate above 25°C	PD PD	225 1.8	mW mW/°C	20, 10 = 0, 1 = 1,0 MHz)
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW	3
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD PD	300	mW mW/°C	Base 2
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW	
Junction and Storage Temperature	TJ, Tstg	150	°C	

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BCW61A = BA; BCW61B = BB; BCW61C = BC; BCW61D = BD

GENERAL PURPOSE TRANSISTOR

BCW61A, BCW61B BCW61C, BCW61D CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)

3 Collector

PNP SILICON

Refer to 2N5086 for graphs.

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, I _B = 0)		V(BR)CEO	32		Vdc
Emitter-Base Breakdown Voltage ($I_E = 1.0 \mu Adc, I_C = 0$)		V(BR)EBO	5.0	-	Vdc
Collector Cutoff Current (V _{CE} = 32 Vdc) (V _{CE} = 32 Vdc, T _A = 150°C)		CES		20 20	nAdc μAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	BCW61A BCW61B BCW61C BCW61D	hFE	20 30 40 100		_
(I _C = 2.0 mAdc, V_{CE} = 5.0 Vdc)	BCW61A BCW61B BCW61C BCW61D		120 140 250 380	220 310 460 630	
(I _C = 50 mAdc, V_{CE} = 1.0 Vdc)	BCW61A BCW61B BCW61C BCW61D		60 80 100 100		
AC Current Gain (IC = 2.0 mAdc, VCE = 5.0 Vdc, f = 1.0 kHz)	BCW61A BCW61B BCW61C BCW61D	hfe	125 175 250 350	250 350 500 700	_
Collector-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 1.25 mAdc) (I _C = 10 mAdc, I _B = 0.25 mAdc)		VCE(sat)	=	0.55 0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 1.25 mAdc) (I _C = 50 mAdc, I _B = 0.25 mAdc)		V _{BE(sat)}	0.68 0.6	1.05 0.85	Vdc
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)		V _{BE} (on)	0.6	0.75	Vdc

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}C$ unless otherwise noted.) Characteristic Symbol Min Max Unit SMALL SIGNAL CHARACTERISTICS Output Capacitance Cobo 80118 6.0 pF $(V_{CE} = 10 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$ Noise Figure dB $(I_C = 0.2 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, R_S = 2.0 \text{ k}\Omega, f = 1.0 \text{ kHz}, BW = 200 \text{ Hz})$ SWITCHING CHARACTERISTICS Turn-On Time 150 ton ns $(I_C = 10 \text{ mAdc}, I_{B1} = 1.0 \text{ mAdc})$ Turn-Off Time toff 800 $(I_{B2} = 1.0 \text{ mAdc}, V_{BB} = 3.6 \text{ Vdc}, R_1 = R_2 = 5.0 \text{ k}\Omega, R_L = 990 \Omega)$

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	32	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	V _{EBO}	5.0	Vdc
Collector Current — Continuous	Ic	800	mAdd

THERMAL CHARACTERISTICS

	Characteristic	Symbol	Max	Unit
Total Device	Dissipation FR-5 Board,*	PD	225	mW
T _A = 25°C Derate abo			1.8	mW/°C
Thermal Res	istance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Alumina S	Dissipation ubstrate,** T _A = 25°C	PD	300	mW
Derate abo	ove 25°C		2.4	mW/°C
Thermal Res	istance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and	Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

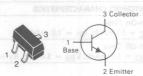
**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

BCW65A = EA

BCW65A

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	32	-	_	Vdc
Collector-Emitter Breakdown Voltage (I _C = 10 μAdc, V _{EB} = 0)	V(BR)CES	60	-	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	_	-	Vdc
Collector Cutoff Current (V _{CE} = 32 Vdc, I _E = 0) (V _{CE} = 32 Vdc, I _E = 0, T _A = 150°C)	ICES	Ξ	_	20 20	nAdo μAdo
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	I _{EBO}	_	_	20	nAdd
ON CHARACTERISTICS					
DC Current Gain $ \begin{aligned} &(I_{\text{C}} = 100 \; \mu\text{Adc}, V_{\text{CE}} = 10 \; \text{Vdc}) \\ &(I_{\text{C}} = 10 \; \text{mAdc}, V_{\text{CE}} = 1.0 \; \text{Vdc}) \\ &(I_{\text{C}} = 100 \; \text{mAdc}, V_{\text{CE}} = 1.0 \; \text{Vdc}) \\ &(I_{\text{C}} = 500 \; \text{mAdc}, V_{\text{CE}} = 2.0 \; \text{Vdc}) \end{aligned} $	hFE	35 75 100 35		220 250 —	_
Collector-Emitter Saturation Voltage (IC = 500 mAdc, I _B = 50 mAdc) (IC = 100 mAdc, I _B = 10 mAdc)	VCE(sat)	=	0.7 0.3	_	Vdc
Base-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)	VBE(sat)	_	_	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	100		_	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_{E} = 0$, $f = 1.0 \text{ MHz}$)	C _{obo}	-	_	12	pF
Input Capacitance $(V_{EB}=0.5\ V_{C}=0, f=1.0\ MHz)$	C _{ibo}	_	_	80	pF
Noise Figure (I _C = 0.2 mAdc, V_{CE} = 5.0 Vdc, R_S = 1.0 k Ω , f = 1.0 kHz, BW = 200 Hz)	NF	-	-	10	dB
SWITCHING CHARACTERISTICS					
Turn-On Time (I _{B1} = I _{B2} = 15 mAdc)	ton	_	_	100	ns
Turn-Off Time (I _C = 150 mAdc, R _L = 150 Ω)	toff	-	-	400	ns

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	75 08	Vdc
Emitter-Base Voltage	VEBO	5.0	⊕ å Vdc
Collector Current — Continuous	Ic ship	800	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	Wm 300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	oar °C

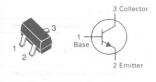
^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

BCW66H = EF

BCW66H

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Characteris		Property of the said	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	Symbol		293	SIVE TO PROPERTY.			
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	Увянсь		V(BR)CEO	45	e		Vdc
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu Adc, V_{EB} = 0$)		Series	V(BR)CES	75	_	£	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	833(88) ^V	Series	V(BR)EBO	5.0	ov award	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Vdc
Collector Cutoff Current (V _{CE} = 45 Vdc, I _C = 0) (V _{CE} = 45 Vdc, I _C = 0, T_A = 150°C)	OSS(SS)V		CES	_	thuge or	20 20	nAdc μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	\$30,	Saine	IEBO	_		20	nAdc
ON CHARACTERISTICS		Series	Valv/D8	10/02	- a (.)	10 10 10	
DC Current Gain ($I_C = 100 \ \mu Adc, \ V_{CE} = 10 \ V$) ($I_C = 10 \ mAdc, \ V_{CE} = 10 \ V$) ($I_C = 100 \ mAdc, \ V_{CE} = 10 \ V$) ($I_C = 500 \ mAdc, \ V_{CE} = 2.0 \ Vdc$)			h _{FE}	35 75 100 35	=	250	-
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	- 340	A.68.F 3.68G	VCE(sat)	_	0.7 0.3		Vdc
Base-Emitter Saturation Voltage (IC = 500 mAdc, IB = 50 mAdc)		7,88,F	V _{BE} (sat)		-	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	381	599,8	BCW87				
Current-Gain — Bandwidth Product (IC = 20 mAdc, VCE = 10 Vdc, f = 100 ldc)	MHz)	3.83 A	f _T	100		-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)		088.5	Cobo	_	_	12	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	VCE(sat)		Cibo	- yi-aya 008 - si	tav m ar	80	pF
Noise Figure (I _C = 0.2 mAdc, V_{CE} = 5.0 Vdc, R_{S} = 1 f = 1.0 kHz, BW = 200 Hz)	.0 kΩ,		NF	- aon	na sipire Saasii Ove		dB
SWITCHING CHARACTERISTICS	1		1071	A Carry	27 - 371	8 1. T. T.	
Turn-On Time $(I_{B1} = I_{B2} = 15 \text{ mAdc})$	Cibo		ton		50 - 93 80x	100	ns
Turn-Off Time (I _C = 150 mAdc, R _L = 150 Ω)	刊	(3)	toff	0.8 _ 55° (5H 06A.	2 <u>m</u> 465. W8 ,8W	400	ns

Rating	Symbol	BCW67	BCW68	Unit
Collector-Emitter Voltage	VCEO	32 JaV	45	Vdc
Collector-Base Voltage	VCBO	45 ob V	60	Vdc
Emitter-Base Voltage	VEBO	5.0 Vice	5,0	Vdc
Collector Current — Continuous	Ic	800	008	mAdd

THERMAL CHARACTERISTICS

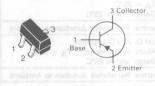
Characteristic	Symbol	Max Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	Wm 300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

DEVICE MARKING

BCW67 = DD; BCW68 = DP; BCW67A = DA; BCW67B = DB; BCW67C = DC; BCW68F = DF; BCW68G = DH

BCW67,A,B,C BCW68.F.G

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

	Character	istic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	38	T was made I			anns	inti mumbula	enit restrict	i satrestia
Collector-Emitter Breakdown Vol-	tage	- USUSTAUST		V(BR)CEO		(0 =	gi sbaw i	Vdc
(I _C = 10 mAdc, I _B = 0)	75	BCW67 S BCW68 S			32 45	alcown Vo	mit selimi	oliector
Collector-Emitter Breakdown Vol $(I_C = 10 \mu Adc, V_{EB} = 0)$	tage	BCW67 : BCW68 :		V(BR)CES	45 60	gatloV mws = 0)	toleanil so gl., op Au,	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		550		V(BR)EBO	5.0	7(0 = = aT_0 =	45 Vool lo	Vdc
Collector Cutoff Current (VCE = 32 Vdc, IE = 0) (VCE = 45 Vdc, IE = 0)	45000	BCW67	Series	ICES	-	-	20 20 10	nAdc
$(V_{CE} = 32 \text{ Vdc}, I_{B} = 0, T_{A} = 0)$ $(V_{CE} = 45 \text{ Vdc}, I_{B} = 0, T_{A} = 0)$		BCW67			_	_	10	μAdc
Emitter Cutoff Current (VFR = 4.0 Vdc, IC = 0)	38			IEBO	-	(V 0L = 80	20	nAdd
ON CHARACTERISTICS	100				foli	100 = 10 m	Labam 00	18 = 51
DC Current Gain (I _C = 10 mAdc, V _{CE} = 1.0 Vdc	c)	BCW67,	3,68G	hFE	75 120	toV noitstu Am 0a = g Am 01 = s	A Jab Am Us	E = 50
(I _C = 100 mAdc, V _{CE} = 1.0 V _C	dc)	BCW670 BCW67, BCW67E	A,68,F		180 100 160	on Voltage § = <u>10</u> mA unac - Ente		
(I _C = 300 mAdc, V _{CE} = 1.0 V _C	001 dc)	BCW670		(sH)	250 35	Iveidin Prod E = 10 Vd	630	urrent G
- 12 pF		BCW676			60 100	r = 1 0 =	pac ila ngsi 10 Ve bilg	undun Ca IVcs =
Collector-Emitter Saturation Volt	age (I _C	= 300 mAdc, I _B	= 30 mAdc)	V _{CE} (sat)	_	-	1.5	Vdc
Base-Emitter Saturation Voltage	$(I_C = 50)$	00 mAdc, IB = 5	0 mAdc)	V _{BE} (sat)	ISHM 0.	= 1.0 =	2.0	Vdc
SMALL-SIGNAL CHARACTERIST	rics	300		Total Assessment		WAR L	Orto Orto C	Olse Page
Current-Gain — Bandwidth Prod (I _C = 20 mAdc, V _{CE} = 10 Vdc		MHz)		fT	100	200 11 2)	- W S ,cit.	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)		Cobo	_	_	18	pF		
Input Capacitance (VEB = 0.5 \	/dc, I _C =	0, f = 1.0 MHz		Cibo		- pb.A	105	pF
Noise Figure $(I_C = 0.2 \text{ mAdc}, \sqrt{f} = 1.0 \text{ kHz}, \text{BW} = 1.0 \text{ kHz}$			(Ω,	NF	-	0.00	10	dB

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

WAXIIIOW NATINGO			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Emitter-Base Voltage	V _{EBO}	5.0	Vdc
Collector Current — Continuous	Ic	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

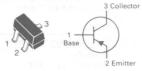
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BCW69 = H1; BCW70 = H2

BCW69 BCW70

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

theU wall oy! Character	istic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					SOLD TO BE	1
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, I _B = 0)	o toleety		V(BR)CEO	45	Bus h	Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 µAdc, V _{EB} = 0)	V(8F)CES		V(BR)CES	50	as valey	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	VIBRICEO		V(BR)EBO	5.0	60 1 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Vdc
Collector Cutoff Current (VCB = 20 Vdc, IE = 0) (VCB = 20 Vdc, IE = 0, TA = 100°C)	Dasman ^V		ІСВО	= = = = = = = = = = = = = = = = = = =	100 10	nAdc μAdc
ON CHARACTERISTICS					0 - 3 - 10 -	
DC Current Gain $(I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	qşd	BCW69 BCW70	hFE	120 215	260 500	4
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc)		BCW71 BCW72	V _{CE(sat)}	10]47 0.8	0.3	Vdc
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)	(real#37V		V _{BE} (on)	0.6	0.75	Vdc
SMALL-SIGNAL CHARACTERISTICS				100-017		
Output Capacitance (IE = 0, VCB = 10 Vdc, f = 1.0 MHz)	Helsell.		C _{obo}	(2 73 A) (3	7.0	pF
Noise Figure (I _C = 0.2 mAdc, V _{CE} = 5.0 Vdc, R _S = 2.0 f = 1.0 kHz, BW = 200 Hz)	kΩ,		NF	29 (3-3)	10	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

WAXIIIOW HATIIIOO			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	50	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	R _θ JA	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

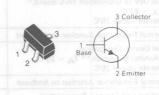
*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BCW71 = K1; BCW72 = AH

BCW71 BCW72

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

Chara	cteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					60	NETTENSTO A	FANO 191
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, V _{EB} = 0)	Vigniceo		V(BR)CEO	45 ₉₉₈	kelav ini Velt = 0)	nitt o- Brez mAde, la	-oVdc
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, V _{EB} = 0)	V(BR)CES		V(BR)CES	45	kelov in Volta 8 = 0)	mit or Gree Made, Vg	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	Ова(яв)V		V(BR)CBO	50	wn V ol tage 0)	e B re skd o aAdo, I c a	
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	-lcso		V(BR)EBO	5.0	— to	uro! -S urre 0 Vda, lg	
Collector Cutoff Current			ІСВО		= AT D =	2 Vdc, 1E	- BOAL
$(V_{CB} = 20 \text{ Vdc}, I_{E} = 0)$				-	- 81	100	
$(V_{CB} = 20 \text{ Vdc}, I_{E} = 0, T_{A} = 100^{\circ}\text{C}$)			_	_	10	μAdc
ON CHARACTERISTICS		80W99		- (s	bV 0.5 = 5	gV pbAin	(1C = 21)
DC Current Gain 000			hFE				
$(I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	VCE(sat)	BCW71 BCW72		110 200	etio m Volter • 0. 5 m Ade	220 450	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc) (I _C = 50 mAdc, I _B = 2.5 mAdc)	(no)38 ^V		VCE(sat)	- (:	0.21	0.25 m	
Base-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 2.5 mAdc)	Coba		V _{BE(sat)}	(44)52	0.85	Bona/ios	Vdc
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)	NF.		V _{BE(on)}	0.6	NV O.B	0.75	Vdc
SMALL SIGNAL CHARACTERISTICS			1570	San Garrie	(sH 00)	te, BW est	(x 0.1 = 1
Current-Gain — Bandwidth Product (IC = 10 mAdc, VCE = 5.0 Vdc, f =	35 MHz)		fT	-	300	_	MHz
Output Capacitance (I _E = 0, V _{CE} = 10 Vdc, f = 1.0 MHz	2)		C _{obo}	-	-	4.0	pF
Input Capacitance (I _C = 0, V _{EB} = 0.5 Vdc, f = 1.0 MH	z)		C _{ibo}		9.0	-	pF
Noise Figure (I _C = 0.2 mAdc, V _{CE} = 5.0 Vdc, R _S f = 1.0 kHz, BW = 200 Hz)	$=$ 2.0 k Ω ,		NF	-	-	10	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

PNP

Base

3 Collector

2 Emitter

BCX17,18 BCX19,20

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)

GENERAL PURPOSE TRANSISTOR

3 Collector

2 Emitter

MAXIMUM RATINGS

		Val	1	
Rating	Symbol	BCX17 BCX19	BCX18 BCX20	Unit
Collector-Emitter Voltage	VCEO	45	45 25	
Collector-Base Voltage	VCBO	50	30	Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	IC IC	500		mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW	
Derate above 25°C		Wm 1.8	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW	
Derate above 25°C		2.4	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW	
Junction and Storage Temperature	TJ, Tstg	150	°C	

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

BCX17 = T1; BCX18 = T2; BCX19 = U1; BCX20 = U2

Charac	teristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	030(88)V			90			
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	Osensal	BCX17,19 BCX18,20	V(BR)CEO	45 25	= 10 = 10		Vdc
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu Adc, I_C = 0$)		BCX17,19 BCX18,20	V _(BR) CES	50 30	Own	/ E = 1	Vdc
Collector Cutoff Current (VCB = 20 Vdc, $I_E = 0$) (VCB = 20 Vdc, $I_E = 0$, $T_A = 150^{\circ}$ C)	083		ICBO	_	= 0	100 5.0	nAdc μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, I _C = 0)			IEBO	=	atvi sii =	10	μAdc
ON CHARACTERISTICS		BCX261					
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc) (I _C = 300 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc)		BCX70K BCX70H BCX70H	hFE	100 70 40	sv Œ -	600	_
Collector-Emitter Saturation Voltage ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)			V _{CE(sat)}	-	— — O.6		Vdc
Base-Emitter On Voltage (IC = 500 mAdc, VCE = 1.0 Vdc)		8C + 763 6CX20H	V _{BE(on)}	-	140°	1.2	Vdc

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	V _{CBO} 45		Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	200	mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW °C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C mW
Total Device Dissipation Alumina Substrate,** TA = 25°C	PD	300	8 mW
Derate above 25°C		2.4	mW °C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C mW
Junction and Storage Temperature	TJ, T _{stq}	150	a.s °C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

BCX70G = AG; BCX70H = AH; BCX70J = AJ; BCX70K = AK

BCX70G,H,J,K

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

Characte	Characteristic					Unit
OFF CHARACTERISTICS		100/01/01/01/01	-1446-4344	cod/A		
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, I _E = 0)	to a constant of		V _(BR) CEO	45	eonapa co	Vdc
Emitter-Base Breakdown Voltage (I _E = 1.0 μAdc, I _C = 0)	V(BR)CEO	BCX17,18	V _{(BR)EBO}	5.0	(0 = gT.onAn	Vdc
Collector Cutoff Current (VCE = 32 Vdc) (VCE = 32 Vdc, TA = 150°C)	PAG(NB)V	BCX17.19	CES	agastoV nv	20 20	nAdc μAdc
Emitter Cutoff Current (V _{EB} = 4.0 Vdc, I _C = 0)	cso	0.00	IEBO		20	nAdc
ON CHARACTERISTICS			10	rber = AT	D = d any	5 = 80V)
DC Current Gain (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	083	BCX70G BCX70H BCX70J	hFE		Current— 1 Vdo -l g = (A) 2 ENSINGS	
(I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)		BCX70K BCX70G BCX70H		100 120 180	220 310	
		BCX70J BCX70K		250 380	460 630	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		BCX70G BCX70H		60 70	On Voltage	
		BCX70J BCX70K		90 100		
Collector-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 1.25 mAdc) (I _C = 10 mAdc, I _B = 0.25 mAdc)			VCE(sat)	=	0.55 0.35	Vdc
Base-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 1.25 mAdc) (I _C = 50 mAdc, I _B = 0.25 mAdc)			VBE(sat)	0.7 0.6	1.05 0.85	Vdc
Base-Emitter On Voltage (IC = 2.0 mAdc, VCE = 5.0 Vdc)			V _{BE} (on)	0.55	0.75	Vdc

Characteristic			Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS	V	6.3	0857		1 Beal	-
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	n Ado	100	f_	125	CHARLET ALL	MHz
Output Capacitance $(V_{CE} = 10 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$			Cobo	Exil For	4.5	pF
Small-Signal Current Gain (IC = 2.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz)	BCX70G BCX70H BCX70H BCX70J BCX70K		ALAR IN	125 175 250 350	250 350 500 700	_
Noise Figure (I _C = 0.2 mAdc, V_{CE} = 5.0 Vdc, R_S = 2.0 k Ω , f = 1.0 kHz, BW = 200 Hz)	0. Wm 8.2		NF	0 - 0	6.0	dB
SWITCHING CHARACTERISTICS		631	7 4			
Turn-On Time (I _C = 10 mAdc, I _{B1} = 1.0 mAdc)			ton	192 to - 107	150	ns
Turn-Off Time (I _{B2} = 1.0 mAdc, V _{BB} = 3.6 Vdc, R1 = R2 = 5.0	κΩ,		toff	_	800	ns
$R_L = 990 \Omega$			NS.	TOXIE LE	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	V
Collector-Base Voltage	VCBO	45	V
Emitter-Base Voltage	VEBO	5.0	V
Collector Current — Continuous	lc lc	100	mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD PD	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD PD	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient	R _θ JA	417	°C/mW
Junction and Storage Temperature	TJ, Tsta	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BCX71G = BG; BCX71J = BJ; BCX71K = BK

BCX71G,J,K

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 2.0 mAdc, I _B = 0)		V(BR)CEO	45	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 1.0 \mu Adc, I_C = 0$)		V _{(BR)EBO}	5.0	-	Vdc
Collector Cutoff Current (V _{CE} = 32 Vdc) (V _{CE} = 32 Vdc, T _A = 150°C)		ICES	=	20 20	nAdc μAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	BCX71G BCX71J BCX71K	hFE		=	_
$(I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	BCX71G BCX71J BCX71K		120 250 380	220 460 630	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	BCX71G BCX71J BCX71K		60 100 110	=	
$(I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz})$	BCX71G BCX71J BCX71K		125 250 350	250 500 700	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 0.25 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 1.25 \text{ mAdc}$)		VCE(sat)	_	0.25 0.55	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 0.25 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 1.25 \text{ mAdc}$)		V _{BE(sat)}	0.6 0.68	0.85 1.05	Vdc
Base-Emitter On Voltage (I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc)		VBE(on)	0.6	0.75	Vdc
Output Capacitance (VCE = 10 Vdc, IC = 0, f = 1.0 MHz)		C _{obo}		6.0	pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

ELECTRICAL CH	IARACTERISTICS (continued) (TA = 25°C unless oth	erwise noted.)			
	Characteristic	Symbol	Min	Max	Unit
Naine Cinner	2.0.0.10	NE		6.0	70

Noise Figure (IC = 0.2 mAdc, VCE = 5.0 Vdc, RS = 2.0 k Ω , f = 1.0 kHz, BW = 200 Hz)

SWITCHING CHARACTERISTICS

Turn-On Time			ton	001	150	ns
$(I_C = 10 \text{ mAdc}, I_{B1} = 1.0 \text{ mAdc})$			09	- bisuff & F	1, 25	
Turn-Off Time (I _{B2} = 1.0 mAdc, V _{BB} = 3.6 Vdc, R1 = R2 = 5.0 k Ω ,	2°Wm	18	toff	_	800	ns
$R_L = 990 \Omega$			ALAB III	nd rid c. no	300 . 1939	

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Gate-Source Voltage	VGS	25	Vdc

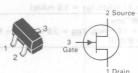
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,*	PD	225	mW
T _A = 25°C Derate above 25°C	tho ³	1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300 2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tsta	150	°C

DEVICE MARKING

BFR30 = M1; BFR31 = M2

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)



JFET AMPLIFIER 1 Drain

N-CHANNEL

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate Reverse Current (V _{GS} = 10 Vdc, V _{DS} = 0)		IGSS	-	0.2	nAdc
Gate Source Cutoff Voltage (ID = 0.5 nAdc, VDS = 10 Vdc)	BFR30 BFR31	V _{GS(off)}		5.0 2.5	Vdc
Gate Source Voltage (ID = 1.0 mAdc, VDS = 10 Vdc) (ID = 50 μ Adc, VDS = 10 Vdc)	BFR30 BFR31 BFR30	VGS	0.7	3.0 1.3 4.0	Vdc
	BFR31		_	2.0	
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain $(V_{DS} = 10 \text{ Vdc}, V_{GS} = 0)$	BFR30 BFR31	IDSS	4.0 1.0	10 5.0	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance $(I_D = 1.0 \text{ mAdc}, V_{DS} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	BFR30 BFR31	Y _{fs}	1.0 1.5	4.0 4.5	mAdc
(ID = 200 μ Adc, VDS = 10 Vdc, f = 1.0 kHz)	BFR30 BFR31		0.5 0.75	_	
Output Admittance (ID = 1.0 mAdc, VDS = 10 Vdc, f = 1.0 kHz) (ID = 200 μ Adc, VDS = 10 Vdc)	BFR31 BFR31	Yos	40 20	25 15	μAdc
Input Capacitance (Ip = 1.0 mAdc, Vps = 10 Vdc, f = 1.0 MHz) (Ip = 200 μ Adc, Vps = 10 Vdc, f = 1.0 MHz)		C _{iss}	_	5.0 4.0	pF
Reverse Transfer Capacitance $(I_D = 1.0 \text{ mAdc}, V_{DS} = 10 \text{ Vdc}, f = 1.0 \text{ MHz})$ $(I_D = 200 \mu\text{Adc}, V_{DS} = 10 \text{ Vdc}, f = 1.0 \text{ MHz})$		C _{rss}	_	1.5 1.5	pF

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	onv 15	ST-Vdc
Collector-Base Voltage	VCBO	aby 20	∃ Vdc
Emitter-Base Voltage	VEBO	aby 2.0	⊕ ⊈ Vdc
Collector Current — Continuous	Ic	55Am25	mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Hot Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	W/m 225	āss mW ⊚ mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	∂∂°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	Wm 300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	West 417	€1°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	081 °C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

**Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

DEVICE MARKING

BFR92 = P1

BFR92

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS AIM TOTAL	ortanatus (c	7		
Collector-Emitter Breakdown Voltage(1) (IC = 10 mA)	V(BR)CEO	15	117 <u>1</u> 1.	Vdc
Collector-Base Breakdown Voltage (IC = 100 µA)	V(BR)CBO	20	_ de	Vdc
Emitter-Base Breakdown Voltage (I _C = 100 μA)	V(BR)EBO	2.0	_ 5x	Vdc
Collector Cutoff Current (V _{CB} = 10 V)	ІСВО	=	50	nA
ON CHARACTERISTICS			1.7	
DC Current Gain (IC = 14 mA, VCE = 10 V)(1)	hFE	25	U-44 1	_
Collector-Emitter Saturation Voltage(1) (IC = 25 mA, IB = 5.0 mA)	VCE(sat)	_	0.5	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 25 mA, I _B = 5.0 mA)	VBE(sat)	-	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS		197		
Current-Gain — Bandwidth Product (IC = 14 mA, V _{CE} = 10 V, f = 500 MHz)	f _T	5 GHz (Typ)	-	MHz
Noise Figure (V _{CE} = 1.5 V, I _C = 3.0 mA, R _S = 50 Ω , f = 500 MHz)	NF	Shiriley Irea	3.0 (Typ)	dB
Capacitance-Collector to Base (V _{CB} = 10 Vdc, f = 1.0 MHz)	C _{cb}	ADITMET:	0.7 (Typ)	pF

⁽¹⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	ab\$\h 12	al Vdc
Collector-Base Voltage	VCBO	abV 15	03 Vdc
Emitter-Base Voltage	VEBO	2.0	0.5 Vdc
Collector Current — Continuous	Ic	25	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	TI°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	087 °C

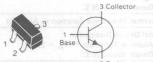
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BFR93 = R1

BFR93

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



RF TRANSISTOR

NPN SILICON

C	haracteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Visaicso		HagatloV nw	obdestill tell	mä- erualto
Collector-Emitter Breakdown Voltage (I _C = 10 mA)		V(BR)CEO	12 apailoV r	(A)	Vdc
Collector-Base Breakdown Voltage (IC = 10 µA)	Canada	V(BR)CBO	15	A.A. Breaktlown	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μA)	onal	V(BR)EBO	2.0	[Au	Vdc
Collector Cutoff Current (VCE = 10 V)		ICEO		50	nA M
Collector Cutoff Current (VCB = 10 V)	99/1	СВО	(1)(V)	50 Mg/	(Anama)
Emitter Cutoff Current (VEB = 1.0 V)	Gsat53V	IEBO		iter 10 min	
ON CHARACTERISTICS	HealERV		(f)eosito	Saturation V	iorning-azi
DC Current Gain (I _C = 1.0 mA, V _{CE} = 5.0 V) (I _C = 30 mA, V _{CF} = 5.0 V)		hFE		A B = 5.0 JAL CH ARAC	
Collector-Emitter Saturation Voltage (I _C = 35 mA, I _B = 7.0 mA)	357	VCE(sat)		0.5	
Base-Emitter Saturation Voltage (I _C = 35 mA, I _B = 7.0 mA)	*3	VBE(sat)	ë = pë Am	0.8 =1.2 V a	Vdc
SMALL-SIGNAL CHARACTERISTICS	44		MHz)	Vde.1 = 1.0	
Current-Gain — Bandwidth Product (I _C = 30 mA, V _{CE} = 5.0 V, f = 50	0 MHz)	f _T	4.5	vitali jen 000	GHz
Noise Figure (VCF = 5.0 V, IC = 2.0 mA, RS =	50 Ω, f = 30 MHz)	NF	-	3.0	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Base Voltage	VCBO	25	Vdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	101 225	mW xxx
Derate above 25°C		Wm 1.8	≥SmW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	Wmv300	mW
Derate above 25°C		Wre 2.4	⊙mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

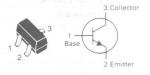
**Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

DEVICE MARKING

BFS17 = E1

BFS17

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



RF TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Cha	aracteristic	Marwise notice)	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	TODAYS.		0/12/38/05/0	15.3		
Collector-Emitter Breakdown Voltage (I _C = 10 mA)	Visiting		V _(BR) CEO	15	Twel-sen	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu A$)	asol		V(BR)CBO	25		Vdc
Collector Cutoff Current (VCE = 10 V)	rantasiV		ICEO	_	25	nA
Collector Cutoff Current (V _{CB} = 10 V)		BSR57 RSR57 RSP64	ICBO	_	25	nA
Emitter Cutoff Current (VEB = 4.0 V)			lEBO	_	100	μΑ
ON CHARACTERISTICS	590,	227,22	n .		12874	
DC Current Gain (I _C = 2.0 mA, V _{CE} = 1.0 V) (I _C = 25 mA, V _{CF} = 1.0 V)	Very	BSR57 BSR68	hFE	20 20	150	_
Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA)		BERSE BERSI	VCE(sat)	,,	0.4	V
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA)	Inol301	88848	V _{BE} (sat)	ung tip	1.0	V
SMALL-SIGNAL CHARACTERISTICS		66 A 2 B		4d // 1	n aan i	
Current-Gain — Bandwidth Product ($I_C = 2.0$ mA, $V_{CE} = 5.0$ V, $f = 500$ ($I_C = 25$ mA, $V_{CE} = 5.0$ V, $f = 500$		85838	fT	1.0 1.3*	Marca <u>a</u> a.c.	GHz
Output Capacitance (VCB = 10 V, f = 1.0 MHz)	b ^T	BSR38	ССВ	V -157	1.0*	pF
Noise Figure $(I_C = 2.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, R_S = 50 \text{ M})$	0 Ω, f = 30 MHz)	85868	NF		5.0*	dB
Тур	7	andre				

*Тур

WAXIIIO W WATIIIO			
Rating	Symbol	Value	Unit
Drain-Source Voltage	± V _{DS}	40	V
Drain-Gate Voltage	V _{DG}	40	V
Gate-Source Voltage	V _{GS}	40	V
Forward Gate Current	I _G (f)	50	mA

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	8.1 mW
Derate above 25°C	-	1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation	PD	300	Wm 24
Alumina Substrate,** T _A = 25°C Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

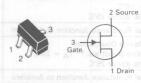
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BSR56 = M4; BSR57 = M5; BSR58 = M6

BSR56 BSR57 BSR58

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)



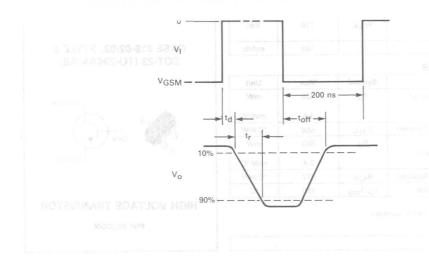
JFET SWITCHING TRANSISTOR

N-CHANNEL

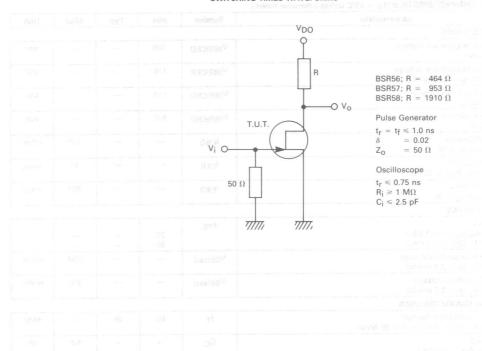
ELECTRICAL CHARACTERISTICS (TA - 28'C online offi

Cha	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Control of Table				- CONTRACTOR	APPENDING STATE
Gate-Source Breakdown Voltage (I _G = 1.0 μ Adc, V _{DS} = 0)	030(88)9		V _(BR) GSS	40	700000000000000000000000000000000000000	Vdc
Gate-Reverse Current (V _{DS} = 0 V, V _{GS} = 20 V)	Odolinali		IGSS	signior	1.0	nA nA
Gate-Source Cutoff Voltage (VDS = 15 V, ID = 0.5 nA)	1080	BSR56 BSR57	VGS(off)	4.0 2.0	10 6.0	(VCE 10
ON CHARACTERISTICS	083	BSR58		0.8	4.0	
Zero-Gate Voltage Drain (VDS = 15 V, VGS = 0)	Sdq	BSR56 BSR57 BSR58	IDSS	50 20 8.0	100	mA MASS STATE OF THE STATE OF T
Drain-Source On Voltage (I _D = 20 mA, V _{GS} = 0) (I _D = 10 mA, V _{GS} = 0) (I _D = 5.0 mA, V _{GS} = 0)	Vertices)	BSR56 BSR57 BSR58	V _{DS(on)}		0.75	VUC
Static Drain-Source On Resistance (ID = 0 mAdc, VGS = 0, f = 1.0 kH		BSR56 BSR57 BSR58	rDS(on)	aor ta ma	25 40 60	Ohms
SWITCHING CHARACTERISTICS			I SHIVI	0 V 1 = 000	no = 35W A	u n'y = 20
Delay Time: V _{DD} = 10 V; V _{GS} = 0 (V _{GSM} = 10 V, I _D = 20 mA) (V _{GSM} = 6.0 V, I _D = 10 mA) (V _{GSM} = 4.0 V, I _D = 5.0 mA)	OCB NF	BSR56 BSR57 BSR58	td	_ (63)	6.0 6.0 10	Output spain (Vog * 10 Noise F gun
Rise Time: $V_{DD} = 10 \text{ V}$; $V_{GS} = 0$ $(V_{GSM} = 10 \text{ V}, I_D = 20 \text{ mA})$ $(V_{GSM} = 6.0 \text{ V}, I_D = 10 \text{ mA})$ $(V_{GSM} = 4.0 \text{ V}, I_D = 5.0 \text{ mA})$		BSR56 BSR57 BSR58	t _r		3.0 4.0 10	ns
Turn-Off Time: $V_{DD} = 10 \text{ V}$; $V_{GS} = 0 \text{ (V}_{GSM} = 10 \text{ V}$, $I_{D} = 20 \text{ mA}$ $(V_{GSM} = 6.0 \text{ V}$, $I_{D} = 10 \text{ mA})$ $(V_{GSM} = 4.0 \text{ V}$, $I_{D} = 5.0 \text{ mA})$		BSR56 BSR57 BSR58	toff	Ξ	25 50 100	ns

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.



SWITCHING TIMES WAVEFORMS



MAYIMI IM PATINGS

WAXIMOW NATINGS				
Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	VCEO	100	Vdc	
Collector-Emitter Voltage RBE = 10 k Ω	VCER	110	Vdc	
Collector Current — Continuous	Ic	100	mAdc	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

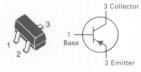
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BSS63 = T1

BSS63

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



HIGH VOLTAGE TRANSISTOR

PNP SILICON

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (IC = 100 µAdc)		V(BR)CEO	100	_	-	Vdc
Collector-Emitter Breakdown Voltage (I _C = 10 μAdc, I _E = 0, R _{BE} = 10 kΩ)		V(BR)CER	110	-	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)		V(BR)CBO	110	-	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc)	Tut	V(BR)EBO	6.0	-	_	Vdc
Collector Cutoff Current (VCB = 90 Vdc, IE = 0) (Q 08 = 08)	4,	СВО	-	-	100	nAdc
Collector Cutoff Current ($V_{CE} = 110 \text{ Vdc}, R_{BE} = 10 \text{ k}\Omega$)	一十	CER	-	-	10	μAdc
Emitter Cutoff Current (VEB = 6.0 Vdc, IC = 0)	H.	IEBO	_	-	200	nAdc
ON CHARACTERISTICS						
DC Current Gain (IC = 10 mAdc, V_{CE} = 1.0 Vdc) (IC = 25 mAdc, V_{CE} = 1.0 Vdc)	li Will	hFE	30 30	=	=	_
Collector-Emitter Saturation Voltage (I _C = 25 mAdc, I _B = 2.5 mAdc)		VCE(sat)	=	-	250	mVdd
Base-Emitter Saturation Voltage (I _C = 25 mAdc, I _B = 2.5 mAdc)		V _{BE(sat)}	-	-	900	mVdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product ($I_C = 25 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 35 \text{ MHz}$)		fT	50	95	-	MHz
Case Capacitance (I _E = I _C = 0, V _{CR} = 10 Vdc)		CC	-	-	5.0	pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	80	Vdc
Collector-Base Voltage	V _{CBO}	120	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	100	mA

THERMAL CHARACTERISTICS

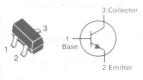
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

DEVICE MARKING

BSS64 = AM

BSS64

CASE 318-03, STYLE 6 SOT-23 (TO-236AA/AB)



DRIVER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Cha	racteristic	rarwiss noted)	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	ledmys		District Control	1.1		
Collector-Emitter Breakdown Voltage (I _C = 4.0 mA)	Оноция		V(BR)CEO	80	1 611	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μA)	овыяви		V(BR)CBO	120	rvi veta -	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μA)	OBS(BB)V		V(BR)EBO	5.0	19.1	Vdc
Collector Cutoff Current (V _{CE} = 90 V) (T _A = 150°C)	cen		ІСВО	_	0.1 500	μΑ
Emitter Cutoff Current (VBE = 4.0 V)			IEBO	_	200	nA
ON CHARACTERISTICS						
DC Current Gain (VCE = 1.0 V, IC = 10 mA)	336	855738	hFE	20	-	
Collector-Emitter Saturation Voltage (I _C = 4.0 mA, I _B = 400 μ A) (I _C = 50 mA, I _B = 15 mA)	((£5)30V	Jerese	VCE(sat)	2 (<u>14</u> 01) 1	0.15 0.2	Vdc
Forward Base-Emitter Voltage			V _{BE(sat)}	_		_
SMALL-SIGNAL CHARACTERISTICS				- 171 E150	T. Carrier and a	
Current-Gain — Bandwidth Product (I _C = 4.0 mA, V_{CE} = 10 V, f = 35 N	1Hz)		Tara no	60	-	MHz
Output Capacitance (VCF = 10 V, f = 1.0 MHz)	300-		C _{ob}	-	5.0	pF

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	75	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	lc lc	100	mAdc

THERMAL CHARACTERISTICS

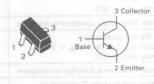
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	OHY °C

DEVICE MARKING

BSS79B = CE; BSS79C = CF

BSS79B BSS79C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL	CHARACT	ERISTICS	(TA	= 25°C	unless	otherwise	noted.)	

CI	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS				month of the	Let Breakde	ma A athelia
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc)	030(88)*		V _(BR) CEO	40	A. J.A.	
Collector-Base Breakdown Voltage (I _C = 10 μAdc)	Galuna)*		V _(BR) CBO	75	A (A maretalises 8	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc)	Ossinai		V _{(BR)EBO}	6.0	A) (A	Vdc
Collector Cutoff Current (V _{CB} = 60 Vdc) (V _{CB} = 60 Vdc, T _A = 150°C)	. 082		СВО	_	10 10	
Emitter Cutoff Current (V _{BE} = 3.0 Vdc)	003		IEBO	_	10 V	nAdc
ON CHARACTERISTICS					13.00	C. Current G.
DC Current Gain (I _C = 150 mAdc, V _{CE} = 10 Vdc)	310	BSS79B BSS79C	hFE	40 100	120 300	(Voge - 1.1
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	(78423507		VCE(sat)		0.3	Vdc
SMALL-SIGNAL CHARACTERISTICS	1. 17681291			phypagait	DASSAID I	MALL-SIGNA
Current-Gain — Bandwidth Product (VCE = 20 Vdc, IC = 20 mAdc, f =	100 MHz)		fT	250	- Bandwidt	MHz
Output Capacitance (V _{CB} = 10 Vdc, f = 1.0 MHz)	Cob		C _{obo}	- (4)	8.0	pF _{crit}
SWITCHING CHARACTERISTICS	the second					
Delay Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ mAdc})$ $(I_{B1} = I_{B2} = 15 \text{ mAdc})$			t _d	-	10	ns
Rise Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ mAdc})$ $(I_{B1} = I_{B2} = 15 \text{ mAdc})$			t _r		10	ns
Storage Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ mAdc})$ $(I_{B1} = I_{B2} = 15 \text{ mAdc})$			ts	-	225	ns
Fall Time (V _{CC} = 30 Vdc, I _C = 150 mAdc) (I _{B1} = I _{B2} = 15 mAdc)			tf	_	60	ns

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	800	mA

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		pints 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	yv. 556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

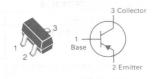
*FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

BSS80B = CH; BSS80C = CJ

BSS80B BSS80C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown \ (I _C = 10 mA)	/oltage	i batan balyangara	V(BR)CEO	40		Vdc
Collector-Base Breakdown Vol (I _C = 10 μA)	tage		V(BR)CBO	60	10-7-2 <u>-</u>	Vdc
Emitter-Base Breakdown Volta ($I_E = 10 \mu A$)	ige		V(BR)EBO	5.0	- Renco	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc) (V _{CB} = 50 Vdc, T _A = 150°C	083-48		ІСВО	_	10 10	nA μA
Emitter Cutoff Current (VBE = 3.0 Vdc)	(Fig.1)		IEBO	_	10	nA
ON CHARACTERISTICS						
DC Current Gain (I _C = 150 mA, V _{CE} = 10 Vc	dc)	BSS80B BSS80C	hFE	40 100	120 300	_
Collector-Emitter Saturation V (I _C = 150 mA, I _B = 15 mA) (I _C = 500 mA, I _B = 50 mA)	4. 934	872558 972558	VCE(sat)	_	0.4 1.6	Vdc
SMALL-SIGNAL CHARACTER	ISTICS			91 17 4 41	181.	
Current-Gain — Bandwidth Pr ($I_C = 50 \text{ mA}, V_{CE} = 20 \text{ Vdc}$			fT	200	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, f = 1.0 MH	z)		C _{obo}		8.0	pF
SWITCHING CHARACTERISTI	cs		1,50410	us le V		
	(I _{B1} ≈ I _{B2} ≈ 15 mA,		t _d	_	10	ns
Rise Time Vo	$_{CC} = 30 \text{ V, I}_{C} = 150 \text{ m/s}$	λ)	t _r	_	40	ns
	₃₁ ≈ I _{B2} ≈ 15 mA,		t _S	_	80	ns
Fall Time	$_{CC} = 30 \text{ V, I}_{C} = 150 \text{ m/s}$	A)	tf	_	30	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	60	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	V _{EBO}	5.0	Vdc

THERMAL CHARACTERISTICS

Symbol	Max	Unit
PD	225	mW
	1.8	mW/°C
$R_{\theta JA}$	556	°C/mW
PD	300	18 mW
	2.4	mW/°C
$R_{\theta}JA$	417	°C/mW
TJ, Tstq	150	°C
	PD R ₀ JA PD R ₀ JA	P _D 225 1.8 R _θ JA 556 P _D 300 2.4 R _θ JA 417

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BSS82B = CH; BSS82C = CM

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

CI	haracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	ованацу	- House of the U		eps/fcV rs	ase Breakdoy	9 - otosiffe
Collector-Emitter Breakdown Voltage (I _C = 10 mA)	oeseseV		V(BR)CEO	60 egasloV	An Leakelow	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μA)	oeni		V(BR)CBO	60	Mentilo Hotel	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA)			V(BR)EBO	5.0	50 Vd <u>al.</u> 30 Vda, T _{A,} =	Vdc
Collector Cutoff Current (VCB = 50 V) (VCB = 50 V, TA = 150°C)	0831		СВО	Ξ	10	nA μA
Emitter Cutoff Current (VEB = 3.0 V)	通用 的	85580E 85580C	IEBO	10 Vdo)	10-16-21	nA nA
ON CHARACTERISTICS	(matth)V			egatieV noi	miner Setura	3- onsilo
DC Current Gain (I _C = 150 mA, V _{CE} = 10 V)		BSS82B BSS82C	hFE	40 100		10 = _01 (1 0 = 50
Collector-Emitter Saturation Voltage (I _C = 150 mA, I _B = 15 mA) (I _C = 500 mA, I _B = 50 mA)	Ħ		VCE(sat)		0.4	
SMALL-SIGNAL CHARACTERISTICS	Cons					re(rectil
Current-Gain — Bandwidth Product (I _C = 50 mA, V _{CE} = 20 V, f = 200	MHz)	10 to 10 to	fT	100	IO VOL. 1 = 1 O CHARACT	MHz
an of -	19 ²		2 = 15 mA,			om T yele

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

PNP SILICON MAN BONVED

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

2.2.2.2.2.3.2.2.2.2.2.2.2.2.2.2.2.2.2.2	V 45		vuc
Drain Current			Adc
Continuous (1)	ID	0.17	0.00
Pulsed (2)	IDM	0.68	0010

THERMAL CHARACTERISTICS

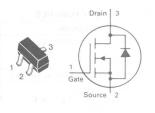
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	R _θ JA	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

BSS123 = 5A

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)



CASE 318-02, STYLE 21 SOT-23 (TO-236AA)

TMOS FET TRANSISTOR

N-CHANNEL

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				93-7-1-2	12
Drain-Source Breakdown Voltage (VGS = 0, ID = 10 μ A)	V _(BR) DSS	100	- <u> </u>		Vdc
Zero Gate Voltage Drain Current (VGS = 0, VDS = 100 V) $T_J = 25$ °C $T_J = 125$ °C	IDSS	_	SLEAL	15 60	nAdc
Gate-Body Leakage Current (VGS = 20 Vdc, VDS = 0)	IGSS	_		50	nAdc
ON CHARACTERISTICS*	170 0 1 1 1 ₁ 0 = 1				
Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 1.0 mA)	V _{GS(th)}	0.8	12:- 0,1	2.8	Vdc
Static Drain-Source On-Resistance (V _{GS} = 10 Vdc, I _D = 100 mA)	rDS(on)	_	5.0	6.0	Ohms
Forward Transconductance (V _{DS} = 25 V, I _D = 100 mA)	9fs	80	(5 <u>0.6</u> 7 0	<u></u>	mmhos
DYNAMIC CHARACTERISTICS			1 20 % #1		
Input Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{iss}	_	20	AS S	pF
Output Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{oss}	_	9.0	3 1/2	pF
Reverse Transfer Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{rss}		4.0	_	pF
SWITCHING CHARACTERISTICS*					
Turn-On Delay Time $(V_{CC} = 30 \text{ V}, I_{C} = 0.28 \text{ A},$	t _d (on)		20		ns
Turn-Off Delay Time $V_{GS} = 10 \text{ V}, R_{GS} = 50 \Omega$	t _d (off)		40		ns
REVERSE DIODE			0.000	Lift a gar	
Diode Forward On-Voltage (I _D = 0.34 A, V _{GS} = 0 V)	V _{SD}	_		1.3	V

⁽¹⁾ The Power Dissipation of the package may result in a lower continuous drain current.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

⁽²⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMOM HATINGO						
Rating	Symbol	Value	Unit			
Drain-Source Voltage	V _{DSS}	100	Vdc			
Gate-Source Voltage	VGS	± 35	Vdc			
Drain Current Continuous (1) Pulsed (2)	I _D	0.17 0.68	Adc			

THERMAL CHARACTERISTICS

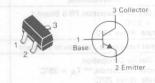
Symbol	Max	Unit
PD	225	mW
	1.8	mW/°C
$R_{\theta JA}$	556	°C/mW
PD	300	mW
	2.4	mW/°C
R_{θ} JA	417	°C/mW
TJ, Tstg	150	°C
	P _D R _θ JA P _D R _θ JA	P _D 225 1.8 R _θ JA 556 P _D 300 2.4 R _θ JA 417

DEVICE MARKING

BSV52 = B2

BSV52

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL	. CHARACTERISTICS	(TA =	25°C unless	otherwise no	ted.)
------------	-------------------	-------	-------------	--------------	-------

Chara	cteristi	C Independ	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					BOMBIRGS	DATAHO 39
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc)	100	SSG(88)A	V(BR)CEO	12	niwatalan d	Vdc
Collector Cutoff Current $(V_{CB} = 10 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 10 \text{ Vdc}, I_E = 0, T_A = 125^{\circ}\text{C})$		38.01	СВО	urrent N TJ = 25°	100 5.0	nAdc μAdc
ON CHARACTERISTICS		NAME OF THE PARTY		- 20	organia arresto	a i shoB-au
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 50 mAdc, V _{CE} = 1.0 Vdc)	8.0	ImsaV	hFE	25 40 25	120	(Vo s. – 30 N CHAR YOT ste Threshal
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 300 μ Adc) (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)		(noi20)	VCE(sat)	9 <u>30</u> 051610 <u>11</u> Am 00	300 250 400	mVdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)			VBE(sat)	700 838	850 1200	mVdc
SMALL-SIGNAL CHARACTERISTICS		551-2		sHM o.r = 1	Die anV V	25 = 25 V
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc)		BROD.	fT	400	ianes V Veg = 0	
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)		Cras	C _{obo}	nce - t = 1.0 MHz	4.0	ener pFier
Input Capacitance (V _{EB} = 1.0 Vdc, I _C = 0)			C _{ibo}	enice -	4.5	o or mpFym
SWITCHING CHARACTERISTICS		(AGR)	A-85.0 = 31	VIA = 30 V		The State of the S
Storage Time $(I_C = I_B = I_{BM} = 10 \text{ mAdc})$		I tholes I	t _s		13	ns
Turn-On Time (VBE = 1.5 Vdc, I _C = 10 mAdc, I _B = 3	3.0 mAd	de)	ton	= 6	12	ns
Turn-Off Time (I _C = 10 mAdc, I _B = 3.0 mAdc)		Minnose drain current,	toff	r the <u>p</u> eckegs uny Cydle ≤ 2	18	ns

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Voltage Range	VZ(nom)	4.7 to 33	Vdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	os PD	225	mW
Derate above 25°C	007	1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

BZX84C4V7 thru BZX84C33

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



3 O O 1 Cathode Anode

ZENER DIODES

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

		Characteristi	ic		Symbol	Min	Max	Unit
OFF CHARACTERIS	TICS		100	b 116				
Forward Voltage (I _F = 10 mAdc)		325	BZX84C Series	2 52 1	VF	T- s	0.9	Vdc
Reverse Voltage Leakage Current			IR			μAdc		
$(V_R = 2.0 \text{ Vdc})$			BZX84C4V7			-	3.0	
			BZX84C5V1 BZX84C5V6		(Amusel	_	2.0	
			DZX04C5V6		The court of		1.0	
$(V_R = 4.0 \text{ Vdc})$			BZX84C6V2				3.0	
(VK - 4.0 Vac)			BZX84C6V8		8	9	2.0	1000
					1 8			
$(V_R = 5.0 \text{ Vdc})$			BZX84C7V5				1.0	
			BZX84C8V2		4	_	0.7	
					3			
$(V_R = 6.0 \text{ Vdc})$			BZX84C9V1			-	0.5	
$(V_R = 7.0 \text{ Vdc})$			BZX84C10	27 00		_	0.2	
$(V_R = 8.0 \text{ Vdc})$			BZX84C11, C12, C	.13		_	0.1	
$(V_R = 0.70 V_Z)$			BZX84C15 to BZX	84C33	1 2	_	0.05	

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

ZENER VOLTAGE

	15.8413	V _{Z3} (V)				ΔVZ/Δ	T(nV/k)		
Device	Marking	IZ3(mA)	Min	Max	$Z_{ZT1}(\Omega)$	$Z_{ZT2}(\Omega)$	$Z_{ZT3}(\Omega)$	Min	Max
BZX84C4V7	Z1	20	4.5	5.4	80	500	15	-3.5	0.2
BZX84C5V1	80 Z2	20	5.0	5.9	60	480	15	9n - 2.7	1.2
BZX84C5V6	Z3 Z3	20	5.2	6.3	40	400	10	-2.0	2.5
BZX84C6V2	Z4	20	5.8	6.8	10	150	6	0.4	3.7
BZX84C6V8	Z5	20	6.4	7.4	15	80	6	1.2	4.5
BZX84C7V5	Z6	20	7.0	8.0	15	80	6	2.5	5.3
BZX84C8V2	Z7	20	7.7	8.8	15	80	6	3.2	6.2
BZX84C9V1	Z8	20	8.5	9.7	15	100	8	3.8	7.0
BZX84C10	Z9	20	9.4	10.7	20	150	10	4.5	8.0
BZX84C11	Y1	20	10.4	11.8	20	150	10	5.4	9.0
BZX84C12	Y2	20	11.4	12.9	25	150	010 = A	6.0	10 A
BZX84C13	Y3	20	12.5	14.2	30	170	15	7.0	11
BZX84C15	Y4	20	13.9	15.7	30	200	20	9.2	13
BZX84C16	Y5	20	15.4	17.2	40	200	20	10.4	14
BZX84C18	Y6	20	16.9	19.2	45	225	20	12.4	16
BZX84C20	Y7	20	18.9	21.4	55	225	20	14.4	18
BZX84C22	Y8	20	20.9	23.4	55	250	25	16.4	20
BZX84C24	Y9	20	22.9	25.7	70	250	25	18.4	22
BZX84C27	Y10	10	25.2	29.3	80	300	45	21.4	25.3
BZX84C30	Y11	10	28.1	32.4	80	300	50	24.4	29.4
BZX84C33	Y12	10	31.1	35.4	80	325	55	27.4	33.4

obAu		RI-				eakage Current	etze Voltage
	5		VZ	1(V)		V	Z2(V)
Device	Marking	IZ1(mA)	Min	Max	IZ1(mA)	Min	Max
BZX84C4V7	Z1	5	4.4	5.0	1	3.7	4.7
BZX84C5V1	Z2	5	4.8	5.4	1	4.2	5.3
BZX84C5V6	Z3	5	5.2	6.0	1	4.8	6.0
BZX84C6V2	Z4	5	5.8	6.6	1	5.6	6.6
BZX84C6V8	Z5	5	6.4	7.2	1	6.3	7.2
BZX84C7V5	Z6	5	7.0	7.9	1	6.9	(aby 0.3 7.9)
BZX84C8V2	Z7	5	7.7	8.7	1	7.6	8.7
BZX84C9V1	Z8 —	5	8.5	9.6	1	8.4	V 05 9.6
BZX84C10	Z9	5	9.4	10.6	1	9.3	10.6
BZX84C11	Y1	5	10.4	11.6	1	10.2	11.6
BZX84C12	Y2	5	11.4	12.7	1	11.2	12.7
BZX84C13	Y3	5	12.4	14.1	1	12.3	14
BZX84C15	Y4	5	13.8	15.6	1	13.7	15.5
BZX84C16	Y5	5	15.3	17.1	1	15.2	17
BZX84C18	Y6	5	16.8	19.1	1	16.7	19
BZX84C20	Y7	5	18.8	21.2	1	18.7	21.1
BZX84C22	Y8	5	20.8	23.3	1	20.7	23.2
BZX84C24	Y9	5	22.8	25.6	1	22.7	25.5
BZX84C27	Y10	2	25.1	28.9	0.5	25	28.9
BZX84C30	Y11	2	28	32	0.5	27.8	32
BZX84C33	Y12	2	31	35	0.5	30.8	35

Rating	Symbol	Value	Unit
Continuous Reverse Voltage	VR	70	Vdc
Peak Forward Current	le le	A 100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MBAL99 = TFX

MBAL99

CASE 318-02/03, STYLE 17 SOT-23 (TO-236AA/AB)



Anode Cathode

SWITCHING DIODE

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			SELL COLOUR	
Reverse Voltage Leakage Current $(V_R = 70 \text{ V})$ $(V_R = 25 \text{ V}, T_J = 150^{\circ}\text{C})$ $(V_R = 70 \text{ V}, T_J = 150^{\circ}\text{C})$	l _R		2.5 30 50	μΑ
Reverse Breakdown Voltage (I _R = 100 µA)	V(BR)	70	Hirv <u>pla</u> Chile	V
Forward Voltage (IF = 1.0 mA) (IF = 10 mA) (IF = 50 mA) (IF = 50 mA)	VF		715 855 1100 1300	mV
Recovery Current (IF = 10 mA, V _R = 5.0 V, R _L = 500 Ω)	QS	_	45	рС
Diode Capacitance (V _R = 0, f = 1.0 MHz)	CD		1.5	pF
Reverse Recovery Time (IF = IR = 10 mA, RL = 100 Ω , measured at IR = 1.0 mA)	t _{rr}	14.75	15	ns
Forward Recovery Voltage (I _F = 10 mA, t _r = 20 ns)	VFR	5 - JE y m i	1.75	V

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Continuous Reverse Voltage	VR	75 n	Vdc
Peak Forward Current	l _F	200	mAdc
Peak Forward Surge Current	IFM(surge)	500	mA

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Vm 0 417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	OB C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MBAS16 = A6

MBAS16

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



SWITCHING DIODE

Ch	aracteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				ACITE RESPUES	DEF CHARA
Reverse Voltage Leakage Current ($V_R = 75 \text{ V}$) ($V_R = 75 \text{ V}$, $T_J = 150 ^{\circ}\text{C}$) ($V_R = 25 \text{ V}$, $T_J = 150 ^{\circ}\text{C}$)	gl	IR	Current	1.0 50 30	μΑ (V) (V) (V) (V) (V) (V) (V) (V) (V) (V)
Reverse Breakdown Voltage $(I_{BR} = 100 \mu A)$		V _(BR)	75	stigV awoots	Neverse Ere
Forward Voltage (IF = 1.0 mA) (IF = 10 mA) (IF = 50 mA) (IF = 100 mA)	Ϋ́	VF	=	715 855 1100 1300	Vmd Vd Vd Vd Vd Vd Vd Vd
Diode Capacitance (V _R = 0, f = 1.0 MHz)	80	CD		2.0	pF
Forward Recovery Voltage (I _F = 10 mA, t_{Γ} = 20 ns)	g ³	V _{FR}	=	1.75	Diede Capa
Reverse Recovery Time (I _F = I _R = 10 mA, R _L = 100 Ω)	rd.	t _{rr}	- 0 601	15 18 Am	2.5
Stored Charge (I _F = 10 mA to V_R = 5.0 V, R_L = 5	00 Ω)	QS	- :	45	рС

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	abV 70	Vdc
Forward Current	lF	bAm 200	mAdc
Peak Forward Surge Current	IFM(surge)	500	□ mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Vm 2 417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	oc 15

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MBAV70 = A4X

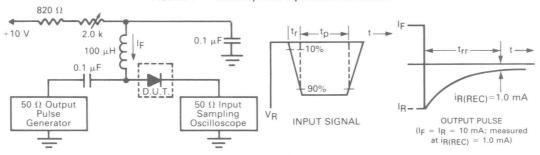
MBAV70 CASE 318-02/03, STYLE 9 SOT-23 (TO-236AA/AB) Anode Anode Anode Anode

SWITCHING DIODE

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Chai	acteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Reverse Breakdown Voltage (I _(BR) = 100 µAdc)		V _(BR)	>70		Vdc
Reverse Voltage Leakage Current $(V_R = 25 \text{ Vdc}, T_J = 150^{\circ}\text{C})$ $(V_R = 70 \text{ Vdc})$ $(V_R = 70 \text{ Vdc}, T_J = 150^{\circ}\text{C})$		IR		60 5.0 100	μAdc
Diode Capacitance (V _R = 0, f = 1.0 MHz)		CD		1.5	pF
Forward Voltage (IF = 1.0 mAdc) (IF = 10 mAdc) (IF = 50 mAdc) (IF = 100 mAdc)	(iii oor — jP. Act o r — pii is boda	VF samm pääm	_748)	715 855 1100 1300	mVdc
Reverse Recovery Time (I _F = I _R = 10 mAdc, V _R = 5.0 Vdc, I	(REC) = 1.0 mAdc) (Figure 1)	t _{rr}	_	15	ns

FIGURE 1 — Recovery Time Equivalent Test Circuit



Notes: 1. A 2.0 kΩ variable resistor adjusted for a Forward Current (I_F) of 10 mA.

- 2. Input pulse is adjusted so IR(peak) is equal to 10 mA.
- 3. tp » trr

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	50	Vdc
Forward Current	1F	200	mAdc
Peak Forward Surge Current	IFM(surge)	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	O° 18∤

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MBAV74 = JAX

MBAV74

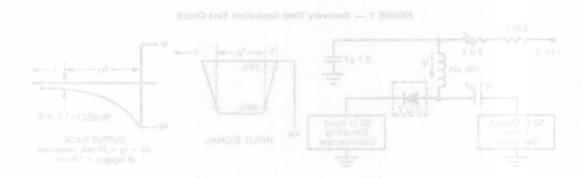
CASE 318-02/03, STYLE 9 SOT-23 (TO-236AA/AB)



SWITCHING DIODE

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

-5.4	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Bridge James	HOUR BLAC	private)	gov-sasa.	in teac
Reverse Breakdown Voltage (I(BR) = 5.0 μAdc)	(AB) ^V	V(BR)	50	Breside	Vdc
Reverse Voltage Leakage Current ($V_R = 50 \text{ Vdc}$, $T_J = 125^{\circ}\text{C}$) ($V_R = 50 \text{ Vdc}$)	al	I _R	.eu <u>ka</u> ge (1 1 = 1601	100 0.1	μAdc
Diode Capacitance (V _R = 0, f = 1.0 MHz)		C _D	180	2.0	pF
Forward Voltage (IF = 100 mAdc)	49	VF	(s Ht //) 0	1.0	Vdc
Reverse Recovery Time (IF = IR = 10 mAdc, iR(REC) = 1.0	0 mAdc, measured at $I_R = 1.0$ mA, $R_L = 100 \Omega$)	t _{rr}	- 1	6A 150.1	ns
1100			-	(ab/Am 08	- 40



^{**}Alumina = 0.4 x 0.3 x 0.024 in, 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	9bV 70	∪√ Vdc
Forward Current	IF	mAm 100	os mAdc
Peak Forward Surge Current	IFM(surge)	15 Am 500	g mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Hall Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{stg}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

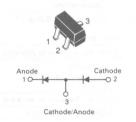
**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MBAV99 = A7X

MBAV99

CASE 318-02/03, STYLE 11 SOT-23 (TO-236AA/AB)

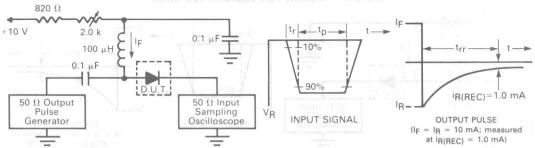


DUAL SERIES SWITCHING DIODE

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Char	racteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				Tall Taller of	
Reverse Breakdown Voltage (I _(BR) = 100 μA)	(RB) ^V	V _(BR)	70	Mar — - 1	Vdc
Reverse Voltage Leakage Current ($V_R = 25 \text{ Vdc}$, $T_J = 150 ^{\circ}\text{C}$) ($V_R = 70 \text{ Vdc}$) ($V_R = 70 \text{ Vdc}$, $T_J = 150 ^{\circ}\text{C}$)	a	l _R	11 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	30 2.5 50	μAdc
Diode Capacitance (V _R = 0, f = 1.0 MHz)		CD	_	1.5	pF
Forward Voltage (IF = 1.0 mAdc) (IF = 10 mAdc) (IF = 50 mAdc) (IF = 100 mAdc)	-fv	VF		715 855 1100 1300	mVdc
Reverse Recovery Time (IF = IR = 10 mAdc, iR(REC) = 1.0 n	nAdc) (Figure 1)	t _{rr}	-	15	ns

FIGURE 1 — Recovery Time Equivalent Test Circuit



Notes: 1. A 2.0 k Ω variable resistor adjusted for a Forward Current (IF) of 10 mA.

2. Input pulse is adjusted so IR(peak) is equal to 10 mA.

3. tp » trr

Rating	Symbol	Value	Unit
Reverse Voltage	VR	bV 70	Vdc
Forward Current	l _F	200	mAdc
Peak Forward Surge Current	IFM(surge)	200	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{stg}	150	°C

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MBAW56 = A1X

MBAW56

CASE 318-02/03, STYLE 12 SOT-23 (TO-236AA/AB)



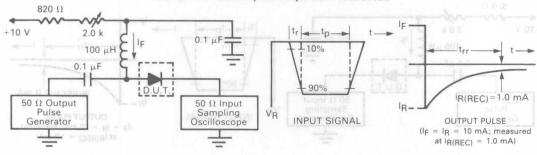
DUAL SWITCHING DIODE

Cathode

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

		Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CTERNSTRES	OFF CHARA
Reverse Breakdown Voltag $(I(BR) = 100 \mu Adc)$	je ot	(A8) ^V	V _(BR)	70 998	elydo <u>ve</u> r V olt 00 uA <u>u</u>	Vdc (AA)
Reverse Voltage Leakage C (V _R = 25 Vdc, T _J = 150 (V _R = 70 Vdc) (V _R = 70 Vdc, T _J = 150	°C) —	R [‡]	IR	— (0°08	30 abv 2.5 abv	$fV_R = 25$ $fV_R = 70$
Diode Capacitance (V _R = 0, f = 1.0 MHz)		G ₂	CD	-	2.5 netic	Dioragorpa (Vg = 0,
Forward Voltage (IF = 1.0 mAdc) (IF = 10 mAdc) (IF = 50 mAdc) (IF = 100 mAdc)	-	:IN:	V _F	Ξ	715 855 1100	mVdca4
Reverse Recovery Time (IF = IR = 10 mAdc, IR(I	REC) =	1.0 mAdc) (Figure 1)	trr (r (nagi) (abArn	er = panir	emil15 svoi	ens en

FIGURE 1 — Recovery Time Equivalent Test Circuit



Notes: 1. A 2.0 k Ω variable resistor adjusted for a Forward Current (IF) of 10 mA.

2. Input pulse is adjusted so I_R(peak) is equal to 10 mA.

3. tp » trr

SO M Pin Diagram

MMAD130 MMAD1103 thru MMAD1107 MMAD1109

CASE 751A-02 SO-14



MONOLITHIC DIODE ARRAYS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Reverse Voltage	V _{RM}	50	Vdc
Steady-State Reverse Voltage	V _R	40	Vdc
Peak Forward Current 25°C	IFM	500	mA
Continuous Forward Current	l _E	400	mA
Power Dissipation Derating Factor	PD	500 4.0	mW mW/°C
Operating Temperature	TA	-65 to +125	°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

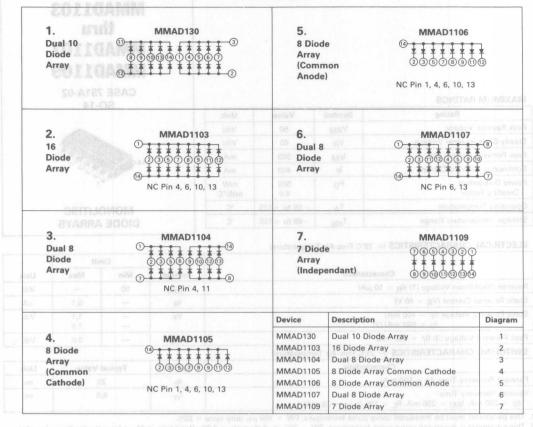
ELECTRICAL CHARACTERISTICS (@ 25°C Free-Air Temperature)

	-66	14 0 0 0 B	Limit		
Characteristic Characteristic	2111	Symbol	Min	Max	Unit
Reverse Breakdown Voltage (1) (IR $=$ 10 μ A)	15	V _(BR)	50		Vdc
Static Reverse Current (V _R = 40 V)		IR	_	0.1	μΑ
Static Forward Voltage (I _F = 100 mA) (I _F = 500 mA) (2)		VF	_	1.1 1.5	Vdc
Peak Forward Voltage (3) (IF = 500 mA) and an insural DEFGAMIN	24/1	VFM	_	5.0	Vdc

SWITCHING CHARACTERISTICS (@ 25°C Free-Air Temperature)

Characteristic	Symbol	Typical Value	Unit	
Forward Recovery Time (I _F = 500 mA)	tfr	20	ns	
Reverse Recovery Time (I _F = 200 mA, I _{RM} = 200 mA, R _I = 100 Ω , i _{rr} = 20 mA)	t _{rr}	8.0	ns	

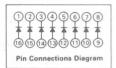
- 1. This parameter must be measured using pulse techniques. PW = 100 μ s, duty cycle \leq 20%.
- 2. This parameter is measured using pulse techniques. PW = 300 μs, duty cycle ≤ 2.0%. Read time is 90 μs from the leading edge of the pulse.
- 3. The initial instantaneous value is measured using pulse techniques. PW = 150 ns, duty cycle ≤ 2.0%, pulse rise time ≤ 10 ns. The total capacitance shunting the diode is 19 pF maximum and the equipment bandwidth is 80 MHz.



MMAD1108

CASE 751B-03 SO-16





MONOLITHIC **DIODE ARRAY**

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Reverse Voltage	V _{RM}	50	Vdc
Steady-State Reverse Voltage	VR	40	Vdc
Peak Forward Current 25°C	IFM	500	mA
Continuous Forward Current	1F	400	mA
Power Dissipation Derating Factor	PD	500 4.0	mW mW/°C
Operating Temperature	TA	-65 to +125	°C
Storage Temperature Range	T _{stq}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (@ 25°C Free-Air Temperature)

	ALL VALUE ALL P	Limit			
Characteristic	Symbol		Max	Unit	
Reverse Breakdown Voltage (1) (IR = 10 μ A)	V _(BR)	50		Vdc	
Static Reverse Current (V _R = 40 V)	IR	_	0.1	μΑ	
Static Forward Voltage (IF = 100 mA) (IF = 500 mA) (2)	VF	4 <u>(11)</u> 4 14	1.1 1.5	Vdc	
Peak Forward Voltage (3) (IF = 500 mA)	V _{FM}		5.0	Vdc	

SWITCHING CHARACTERISTICS (@ 25°C Free-Air Temperature)

Characteristic	Symbol	Typical Value	Unit
Forward Recovery Time (I _F = 500 mA)	t _{fr}	20	ns
Reverse Recovery Time (IF = 200 mA, IRM = 200 mA, RL = 100 Ω , Irr = 20 mA)	t _{rr}	0,8	ns

- 1. This parameter must be measured using pulse techniques. PW = $100 \mu s$, duty cycle $\leq 20\%$. 2. This parameter is measured using pulse techniques. PW = $300 \mu s$, duty cycle $\leq 2.0\%$. Read time is $90 \mu s$ from the leading edge of the pulse.
- 3. The initial instantaneous value is measured using pulse techniques. PW = 150 ns, duty cycle ≤ 2.0%, pulse rise time ≤ 10 ns. The total capacitance shunting the diode is 19 pF maximum and the equipment bandwidth is 80 MHz.

Limiter-base voltage		VEBO	5.0	Vdc
Collector Current — Con	tinuous	Ic	50	mAdc

THERMAL CHARACTERISTICS

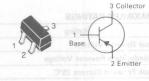
Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD		mW mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW	
Junction and Storage Temperature	TJ, Tstg	150	°C	

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

 $MMBA811C5 \,=\, C5;\, MMBA811C6 \,=\, C6;\, MMBA811C7 \,=\, C7;\, MMBA811C8 \,=\, C8$

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

tinU xaM niM (Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	(88)V			(1) agail	eV-mwohalaste	iztovoti
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc)	BI		V(BR)CEO	45	verse Current	Vdc
Collector-Base Breakdown Voltage $(I_C = 100 \mu Adc)$			V(BR)CBO	50	epsileV brew	Vdc
Emitter-Base Breakdown Voltage (I _C = 10 µAdc)			V _{(BR)EBO}	5.0	(\$) (8 m 00	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc)	MHX		СВО		50	nAdd
Emitter Cutoff Current (VEB = 5.0 Vdc)	Symbol	(evusyagme) na i	IEBO	ON I CUITATI	50	nAdd
ON CHARACTERISTICS	100				Accovery Time	raswiol
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 3.0 Vdc) (I _C = 0.5 mAdc, V _{CE} = 3.0 Vdc)	19 ¹	- 20 mA)	hFE ni .00 001 = J	135	900	Reversi
(For Reference Only) (IC = 0.5 mAdc, VCE = 3.0 Vdc)		MMBA811C6 MMBA811C7	l using pulse t pulse techniq neasured usin	135 200 300		This p is pulse. The insti-
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		MMBA811C8	VCE(sat)	450	0.3	Vdc
Base-Emitter On Voltage (I _C = 0.5 mAdc, V _{CE} = 3.0 Vdc)		V.	V _{BE(on)}	0.5	0.65	Vdc
SMALL SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (IC = 1.0 mAdc, VCF = 6.0 Vdc, f	- 100 MHz)		fT	75		MHz

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

	* CDU		* 40
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	lc	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	MintJ 225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation	PD	300	e mW
Alumina Substrate,** T _A = 25°C Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

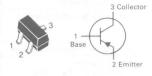
^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBA812M3 = M3; MMBA812M4 = M4; MMBA812M5 = M5;

MMBA812M6 = M6; MMBA812M7 = M7

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

CI	haracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS						ace Test Since	
Collector Cutoff Current (VCB = 40 Vdc, IE = 0)		OHIT		СВО	_	0.1	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)				IEBO	-	0.1	μAdc
ON CHARACTERISTICS		1971					
DC Current Gain $(V_{CE} = 6.0 \text{ Vdc}, I_{C} = 1.0 \text{ mAdc})$	007	D82(20Y	MMBA812M3 MMBA812M4 MMBA812M5 MMBA812M6 MMBA812M7	hFE	60 90 135 200 300	120 180 270 400 600	_
Collector-Emitter Saturation Voltage ($I_C = 30 \text{ mAdc}$, $I_B = 3.0 \text{ mAdc}$)				VCE(sat)	_	0.5	Vdc
Base-Emitter On Voltage (VCE = 6.0 Vdc, IC = 1.0 mAdc)		- Ppr		V _{BE(on)}	Hin J. I	0.8	Vdc

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	50	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Wm 556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	er °C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

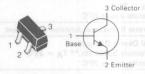
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBC1009F1 = F1; MMBC1009F3 = F3

MMBC1009F1 MMBC1009F3

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



AM/FM RF AMPLIFIER TRANSISTOR

NPN SILICON

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				8	ACTERISME	AND TIO
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)		ICBO		- (0	0.1	μAdc
ON CHARACTERISTICS					thermal tion	
C C	MMBC1009F1 MMBC1009F3	hFE	30 60	_ 8	60 120	ON CHA
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	MMBAS12MS MMBAS12MS	V _{CE(sat)}	-	(sbAm 0.1 a	0.3	Vdc
SMALL-SIGNAL CHARACTERISTICS	MATSARARARA					
Current-Gain Bandwidth Product (I _C = 1.0 mAdc, V _{CE} = 6.0 Vdc, f = 100 MH	tkistuasiani tz)	fT	150	apatioV noite	ude2 remon	MHz
Output Capacitance $(V_{CB} = 6.0 \text{ V, } I_E = 0, f = 1.0 \text{ MHz})$	V	C _{obo}	-	(sb/2.0 0.8	e igl jah Am l ser On Volte	pF
Noise Figure (IC = 0.5 mAdc, VCF = 6.0 Vdc, f = 1.0 MH		NF	-	2.5	60 Ver, 16	dB

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value sum	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	Ic o	HAm 10 cor	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	M	ax	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	22		mW mW/°C
Thermal Resistance Junction to Ambient	R _θ JA	55	6	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	30		mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	41	17	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	15	50 08	°C

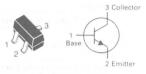
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBC1321Q3 = Q3; MMBC1321Q4 = Q4; MMBC1321Q5 = Q5

MMBC1321Q3 thru MMBC1321Q5

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



VHF/RF AMPLIFIER TRANSISTOR

NPN SILICON

0.1

0.1

Unit

μAdc

Тур

Characteristic	Symbol Mi
OFF CHARACTERISTICS	•
Collector Cutoff Current (V _{CB} = 25 Vdc, I _E = 0)	ICBO —
Emitter Cutoff Current (VEB = 4.0 Vdc, IC = 0)	IEBO —

ON CHARACTERISTICS

ON CHANACTERISTICS						
DC Current Gain (I _C = 2.0 mAdc, V _{CE} = 6.0 Vdc)	MMBC1321Q3 MMBC1321Q4 MMBC1321Q5	hFE	60 90 135	=	120 180 270	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		V _{CE(sat)}		1 (K) 1 (1)	0.6	Vdc

SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product (I _C = 2.0 mAdc , V _{CE} = 6.0 Vdc , f = 100 MHz)	fŢ	600	131048	<i>y</i> <u>-</u>	MHz
Output Capacitance (V _{CB} = 6.0 Vdc, I _E = 0, f = 100 MHz)	C _{obo}	u e	1.3	1.8	pF
Noise Figure (VCE = 6.0 Vdc, IE = 2.0 mAdc, f = 900 MHz, RG = 50 Ω)	NF	_	5.0	_	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value Suit	Unit
Collector-Emitter Voltage	VCEO	oV 35 €	Vdc
Collector-Base Voltage	VCBO	40 P	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	I _C	Am 100	mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 TA	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stg}	150	°C

DEVICE MARKING

MMBC1622D6 = D6; MMBC1622D7 = D7

MMBC1622D6 MMBC1622D7

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

int xaM qvT Chara	cteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				RACTEMETIC	AKS THO
Collector Cutoff Current $(V_{CB} = 25 \text{ Vdc}, I_E = 0)$	O83 ¹	ІСВО	- 40	50 50 S	nAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)	O83 ¹	IEBO	- (0	50 50	nAdc
ON CHARACTERISTICS				SOLISISTIOS	ARD RE
DC Current Gain (V _{CE} = 3.0 Vdc, I _C = 0.1 mAdc) (V _{CE} = 3.0 Vdc, I _C = 0.5 mAdc)	All MMBC1622D6 MMBC1622D7	hFE	150 200 300	400 600	07 <u>_</u> Curren (II _C = 2
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)	Nes/30V	VCE(sat)	lobAm 0.1	0.3	Vdc
Base-Emitter On Voltage (VCE = 3.0 Vdc, IC = 0.5 mAdc)	11	V _{BE(on)}		0.65	Vdc
SMALL-SIGNAL CHARACTERISTICS		(SHM 601 =	t aby 6.8 -	agy JabAm D	1 = 21/
Current-Gain — Bandwidth Product (VCE = 6.0 Vdc, IE = 1.0 mAdc, f = 1)	00 Mhz)	f _T (sHi)	100	panitones 8.0 Vdc, Ig =	MHz

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

	- 000		4
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	WALKER IC	100	mAdc

THERMAL CHARACTERISTICS

Characteristic Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{stq}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBC1623L3 = L3; MMBC1623L4 = L4; MMBC1623L5 = L5;

MMBC1623L6 = L6; MMBC1623L7 = L7

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)

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AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

Charact	teristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				COLUMN TO STATE	
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0)	0801	ICBO		100	nAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)		IEBO	= 8	100	nAdc
ON CHARACTERISTICS				Carried Co.	
DC Current Gain (IC = 1.0 mAdc, VCE = 6.0 Vdc)	MMBC1623L3 MMBC1623L4 MMBC1623L5 MMBC1623L6 MMBC1623L6	hFE	60 90 135 200 300	120 180 270 400 600	_
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)		V _{CE} (sat)	možnici	0.3	Vdc
Base-Emitter Saturation Voltage (I _C = 100 mA, I _B = 10 mAdc)	71	V _{BE} (sat)	830 <u>8</u> 831,3	1.0	Vdc
Base-Emitter On Voltage (I _C = 1.0 mAdc, V _{CE} = 6.0 Vdc)	3	V _{BE} (on)	.60	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS	5555	(:	SHEW S.T	TE STAN	
Current-Gain — Bandwidth Product $(V_{CE} = 6.0 \text{ Vdc}, I_E = 10 \text{ mAdc}, f = 100)$	MHz)	f _T	200	_	MHz

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

		mU o	1000
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	130	Vdc
Collector-Base Voltage	VCBO	150	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW	
Derate above 25°C		1.8	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C	
Thermal Resistance Junction to Ambient	D	417	°C/mW	
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	C/IIIVV	
Junction and Storage Temperature	TJ, Tstg	150	°C	

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBC1653N2 = N2; MMBC1653N3 = N3; MMBC1653N4 = N4

MMBC1653N2,3,4

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





HIGH VOLTAGE TRANSISTOR

NPN SILICON

Chara	cteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					cs	ACTEMIST	AND THO
Collector Cutoff Current (V _{CB} = 100 Vdc, I _E = 0)	0801		СВО	_		0.1	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)	089		IEBO	= =	(d =	0.1	μAdc
ON CHARACTERISTICS					81	ACTURIST	E MED MO
DC Current Gain (V _{CE} = 3.0 Vdc, I _C = 15 mAdc)	940	MMBC1653N2 MMBC1653N3 MMBC1653N4	hFE	50 100 150	oV 0. 0 ≈ g	130 220 330	1-50 0 00 1 = 31
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		ichezalle ichezalle	VCE(sat)	-	-	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)		V _{BE(sat)}			1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	(tag)38V				agailoV no	er Saturatio	lane En ett
Current-Gain — Bandwidth Product (VCE = 10 Vdc, I _F = 10 mAdc, f =	100 MHz)		fŢ	_	150	gr_Ain o	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MH	z)		C _{obo}	908	4.5	AND JAME	pF

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

MAXIMOW NATINGS						
Rating	Symbol	Value	Unit			
Collector-Emitter Voltage	VCEO	160	Vdc			
Collector-Base Voltage	VCBO	180	Vdc			
Emitter-Base Voltage	VEBO	5.0	Vdc			
Collector Current — Continuous	lc.	50	mAdc			

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD .	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBC1654N5 = N5; MMBC1654N6 = N6; MMBC1654N7 = N7

MMBC1654N5,6,7

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





NPN SILICON

Characteris	stic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	1007114 6	J.,		A LOCK HOUSE	·		
Collector Cutoff Current (V _{CB} = 100 V, I _E = 0)	[Agiy		СВО		Tg at	0.1	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)			EBO		par Dige	0.1	μAdc
ON CHARACTERISTICS							
DC Current Gain $(V_{CE} = 3.0 \text{ V}, I_{C} = 15 \text{ mAdc})$	05	MMBC1654N5 MMBC1654N6 MMBC1654N7	hFE	50 100 150	=	130 220 330	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	10		V _{CE(sat)}	-	- 111	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	₹		V _{BE(sat)}	_	-	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	977						
Current-Gain — Bandwidth Product (VCE = 10 Vdc, I _F = 10 mAdc, f = 100 M	ЛНz)		fT	_	150	_	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)			C _{obo}	_	4.5	_	pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C	
Derate above 25 C		1.0	0.1	
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW	
Junction and Storage Temperature	T _J , T _{stq}	150	°C	

DEVICE MARKING

MMBD101 = 4M

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



HOT-CARRIER UHF MIXER DIODE

TAIU JUNE dg i	Characteris	stic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS								PERSONAL PROPERTY.
Reverse Breakdown Voltage (I _R = 10 μAdc)		080		V _(BR)	4.0	- (0	9 7V 001	Vdc
Reverse Voltage Leakage Curren (VR = 3.0 Vdc)	t	Clas.		IR	-		0.25	μAdc
Series Inductance (f = 250 MHz)		Sall	201. 20. 20. 20. 20.	Ls	_	6.0	Cain	nH
Case Capacitance (f = 1.0 MHz)	100		MMBC1854N6 MMBC1854N6	СС	-	0.18	_	pF
Diode Capacitance (V _R = 0, f = 1.0 MHz)		(Int)30V		CT	- ege	noV n oissu		pF
Forward Voltage (I _F = 10 mAdc)		VBE(sat)		V _F	-	ega llo V no	0.60	Vdc
Noise Figure (f = 1.0 GHz)				NF	- 801	6.0	GNN TE CHA	dB
(f = 1.0 GHz)		75		Hz)	70e IAI 051 = 1	eleth Peed = 10 mAde	gl ab	/ 101

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating Dare 12A0	Symbol	Value	Unit
Reverse Voltage	VR	50	Vdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in. **Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

DEVICE MARKING

MMBD201 = 4S; MMBD301 = 4T; MMBD501 = 5F; MMBD701 = 5H

MMBD201 MMBD301 MMBD501 MMBD701

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



3 O O 1 Cathode Anode

HOT-CARRIER DIODE

Charact	Symbol	Min	Тур	Max	Unit		
OFF CHARACTERISTICS							
Reverse Breakdown Voltage (I _R = 10 μAdc)	V(BR)	20 	= = = = = = = = = = = = = = = = = = = =		Vdc		
Reverse Voltage Leakage Current (V _R = 25 Vdc)	2 -	IR	_	_	200	μAdc	
Diode Capacitance (V _R = 20 Vdc, f = 1.0 MHz)		CT		_ 121	1.0	pF	
Forward Voltage (IF = 10 mAdc)		VF	_	_	1.2	Vdc	

Rating	Symbol	Value	Unit
Continuous Reverse Voltage	VR	4.0	VCC

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

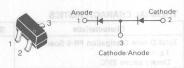
**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MMBD352 = 5G; MMBD353 = 4F

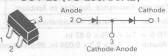
MMBD352

CASE 318-02/03 STYLE 11 SOT-23 (TO-236AA/AB)



MMBD353

CASE 318-02/03 STYLE 19 SOT-23 (TO-236AA/AB)



DUAL HOT CARRIER MIXER DIODE

Typ Wax Unit	Characteristic	Symbo	l Min	Max	Unit
OFF CHARACTERISTICS				SURFRIEN	AZANU MO
Forward Voltage (IF = 10 mA)	V(BR)	rosc Beary VF	_ a0	0.60	ol =V
Reverse Voltage Leakage Current (VR = 3.0 V) (VR = 4.0 V)	50	FORCEMAN IR FORCEMAN	toward	0.25 10	μΑ
Capacitance (V _R = 0 V, f = 1.0 MHz)		С	_	1.0	as = pF/)

MMBD501, MMBD701 For Specifications,

See MMBD201 Data.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Reverse Voltage	VR	70	Vdc
Forward Current	P.J. IF	200	mAdo
Peak Forward Surge Current	IFM(surge)	500	mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBD914X = 5D

MMBD914X

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



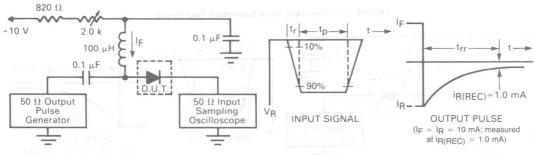


HIGH-SPEED SWITCHING DIODE

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

CH	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	(BB)V			- [
Reverse Breakdown Voltage (I _R = 100 μAdc)		KALBD2836X	V(BR)	100	_	Vdc
Reverse Voltage Leakage Current ($V_R = 20 \text{ Vdc}$) ($V_R = 75 \text{ Vdc}$)	#*	MMSD2830X MMSD2830X	IR	-	25 5.0	nAdc μAdc
Diode Capacitance (V _R = 0, f = 1.0 MHz)	14		CT	_	4.0	pF
Forward Voltage (I _F = 1.0 mAdc)	3.57		VF	_	1.0	Vdc
Reverse Recovery Time (I _F = I _R = 10 mAdc) (Figure 1)			t _{rr}	_	15	ns

FIGURE 1 — Recovery Time Equivalent Test Circuit



- Notes: 1. A 2.0 k Ω variable resistor adjusted for a Forward Current (IF) of 10 mA.
 - 2. Input pulse is adjusted so IR(peak) is equal to 10 mA.
 - 3. tp » trr

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

IF	100	MAGC
Symbol	Max	Unit
PD		mW mW/°C
$R_{\theta JA}$	556	°C/mW
PD	300	mW mW/°C
$R_{\theta JA}$	417	°C/mW
T _J , T _{stg}	150	°C
	Symbol PD ReJA PD	Symbol Max PD 225 1.8 RθJA 556 PD 300 2.4 RθJA 417

DEVICE MARKING

MMBD2835X = A3X; MMBD2836X = A2X

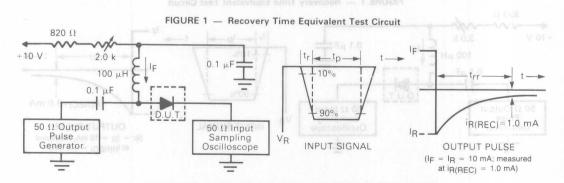
CASE 318-02/03, STYLE 12 SOT-23 (TO-236AA/AB)



DUAL **SWITCHING DIODE**

Cathode (1819)

	Characte	eristic	Libeton salwjarita assi	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	sit/d lock	Syre		oldahestostas	io o		
Reverse Breakdown Voltage				V _(BR)		ACTERISTICS	Vdc
(I _R = 100 μAdc)	100	e)V	MMBD2835X MMBD2836X		35 75	oukdown Volu	
Reverse Voltage Leakage Cur (V _R = 30 Vdc) (V _R = 50 Vdc)	rent		MMBD2835X MMBD2836X	I _R	Current	100 100	nAdc
Diode Capacitance (V _R = 0, f = 1.0 MHz)	- 1	9		CT	<u> </u>	4.0	pF _{ol} O
Forward Voltage (IF = 10 mAdc) (IF = 50 mAdc)				V _F	_	1.0	Vdc
(I _F = 100 mAdc)					_	1.2	
Reverse Recovery Time (IF = IR = 10 mAdc, iR(RE	c) = 1.0 mAdc	(Figure 1)		t _{rr}	(I saugifi	15	ns



- Notes: 1. A 2.0 kΩ variable resistor adjusted for a Forward Current (I_F) of 10 mA.
 - 2. Input pulse is adjusted so IR(peak) is equal to 10 mA.
 - 3. tp " trr

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

MAAVIMI IM DATINGS	'FIVI	300	008 made
Average Rectified Current	Io	150 100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		Wm 1.8	□E mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

*Alumina = 0.4 x 0.3 x 0.0 **DEVICE MARKING**

MMBD2837X = A5X; MMBD2838X = A6X

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

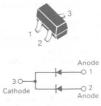
C	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	(98)Y			78-2		
Reverse Breakdown Voltage (I _(BR) = 100 μAdc)	R ^j	MMBD2837X MMBD2838X	V _(BR)	35 75		Vdc
Reverse Voltage Leakage Current $(V_R = 30 \text{ Vdc})$ $(V_R = 50 \text{ Vdc})$	37	MMBD2837X MMBD2838X	l _R	_	0.1 0.1	μAdc
Diode Capacitance (V _R = 0, f = 1.0 MHz)	mi.	Tr.	CT	Tank	4.0	pF
Forward Voltage (I _F = 10 mAdc) (I _F = 50 mAdc) (I _F = 100 mAdc)			VF	=	1.0 1.0 1.2	Vdc
Reverse Recovery Time (I _F = I _R = 10 mAdc, i _R (REC) = 1.0	mAdc) (Figure	1)	t _{rr}	_	15	ns

FIGURE 1 — Recovery Time Equivalent Test Circuit 820 12 +10 V 2.0 k 10% 100 μΗ 0.1 µF iR(REC) = 1.0 mA50 12 Output 50 Ω Input Pulse Sampling VR Oscilloscope INPUT SIGNAL **OUTPUT PULSE** Generator (IF = IB = 10 mA; measured at iR(REC) = 1.0 mA)

Notes: 1. A 2.0 k Ω variable resistor adjusted for a Forward Current (IF) of 10 mA.

- 2. Input pulse is adjusted so IR(peak) is equal to 10 mA.
- 3. tp » trr

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



DUAL SWITCHING DIODE

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	56V 70	Vdc
Forward Current	IF	200	mAdc
Peak Forward Surge Current	IFM(surge)	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,*	PD	225	mW
$T_A = 25^{\circ}C$ Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation	PD	300	mW
Alumina Substrate,** T _A = 25°C Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tsta	150	2° C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBD6050X = 5A

MMBD6050X

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)

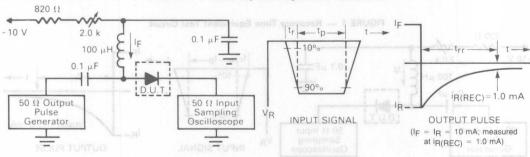


SWITCHING DIODE

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

	Characteristic	I havoo nalwasaho zanin	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Indima?		siteinethinari	0		
Reverse Breakdown Voltage $(I_{(BR)} = 100 \mu Adc)$			V _(BR)	70	BOTEMBTOA	Vdc.
Reverse Voltage Leakage Current (V _R = 50 Vdc)	19814	MMBD2837X MMBD2839X	IR		0.1	μAdc
Forward Voltage (IF = 1.0 mAdc) (IF = 100 mAdc)		MAMBD2867X MAMBD2867X	VF	0.55 0.85	0.7 1.1	
Reverse Recovery Time (I _F = I _R = 10 mAdc, i _R (REC) =	1.0 mAdc) (Figure 1)		t _{rr}		15 ng/m	ns ns
Capacitance (V _R = 0)			С	-	2.5	01 = 20

FIGURE 1 — Recovery Time Equivalent Test Circuit



- IAm U.7 = (page 1) Notes: 1. A 2.0 kΩ variable resistor adjusted for a Forward Current (I_F) of 10 mA.
 - 2. Input pulse is adjusted so IR(peak) is equal to 10 mA.
 - 3. tp " trr

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	70	Vdc
Forward Current	IF	200	mAdc
Peak Forward Surge Current	IFM(surge)	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{\hbox{$A$}} = 25^{\circ}\hbox{C}$ Derate above 25°C	PD	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

DEVICE MARKING

MMBD6100 = 5B

MMBD6100

CASE 318-02/03, STYLE 9 SOT-23 (TO-236AA/AB)

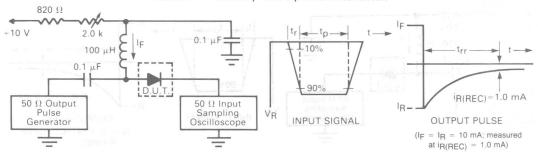


DUAL **SWITCHING DIODE**

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			or haven on	
Reverse Breakdown Voltage (I(BR) = 100 µAdc)	V(BR)	70	to 1 - 1	Vdc
Reverse Voltage Leakage Current (V _R = 50 Vdc)	I _R	-	0.1	μAdc
Forward Voltage (IF = 1.0 mAdc) (IF = 100 mAdc)	V _F	0.55 0.85	0.7 1.1	Vdc
Reverse Recovery Time $(I_F = I_R = 10 \text{ mAdc}, I_R(REC) = 1.0 \text{ mAdc})$ (Figure 1)	² rr	_	15	ns
Capacitance (V _R = 0)	С		2.5	pF

FIGURE 1 — Recovery Time Equivalent Test Circuit



Notes: 1. A 2.0 k Ω variable resistor adjusted for a Forward Current (I_F) of 10 mA.

2. Input pulse is adjusted so $I_{R(peak)}$ is equal to 10 mA.

3. tp » trr

^{*}FR-5 = 1.0 × 0.75 × 0.62 in. **Alumina = 0.4 × 0.3 × 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	100	Vdc
Forward Current	IF S S	200	mAdc
Peak Forward Surge Current	IFM(surge)	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

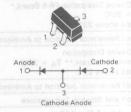
**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MMBD7000 = 5C

MMBD7000

CASE 318-02/03, STYLE 11 SOT-23 (TO-236AA/AB)

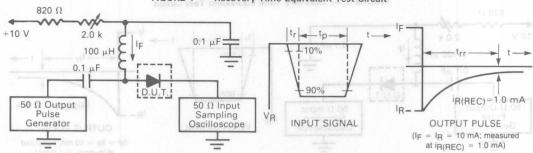


DUAL **SWITCHING DIODE**

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

MinU Smith Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			ACTURES FICE	MARIO 190
Reverse Breakdown Voltage (I(BR) = 100 µAdc)	V(BR)	100	(abAu ₄ 001	Vdc
Reverse Voltage Leakage Current (V _R = 50 Vdc)	I _R	Carrent	0.30	μAdc
(V _R = 100 Vdc) (V _R = 50 Vdc, 125°C)	I _{R2} I _{R3}		0.5 100	Forward Vr (tp = 10
Forward Voltage 88.0	VF		tobiam	Vdc
(I _F = 1.0 mAdc) (I _F = 10 mAdc) (I _F = 100 mAdc)) mAdel (Figure 1)	0.55 0.67 0.75	0.7 0.82 1.1	Raverse Rules Rules
Reverse Recovery Time (IF = IR = 10 mAdc) (Figure 1)	t _{rr}	-	15	ns
Capacitance (V _R = 0)	С	-	1.5	pF

FIGURE 1 — Recovery Time Equivalent Test Circuit



Notes: 1. A 2.0 k Ω variable resistor adjusted for a Forward Current (IF) of 10 mA.

2. Input pulse is adjusted so IR(peak) is equal to 10 mA.

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	60	Vdc
Drain-Gate Voltage	VDGS	60	Vdc
Gate-Source Voltage	V _{GS}	± 20	Vdc
Drain Current — Continuous Pulsed	I _D	0.5 0.8	Adc

THERMAL CHARACTERISTICS

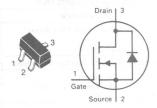
THE THINAL OFFICE OFFIC			
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

DEVICE MARKING

MMBF170 = 6Z

MMBF170

CASE 318-02, STYLE 21 SOT-23 (TO-236AA)



TMOS FET TRANSISTOR

N-CHANNEL

	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	PaardanV		687.868	197 1972 9	
Drain-Source Breakdown Volt	age ($V_{GS} = 0$, $I_{D} = 100 \mu A$)	V(BR)DSS	60		Vdc
Gate-Body Leakage Current, F	Forward ($V_{GSF} = 15 \text{ Vdc}, V_{DS} = 0$)	IGSS		10	nAdo
ON CHARACTERISTICS*		(0.62)	37.1		
Gate Threshold Voltage (VDS	$= V_{GS}, I_{D} = 1.0 \text{ mA})$	V _{GS(th)}	0.8	3.0	Vdc
Static Drain-Source On-Resist	sance ($V_{GS} = 10 \text{ Vdc}$, $I_D = 200 \text{ mA}$)	rDS(on)	_	5.0	Ohm
On-State Drain Current (VDS	= 25 V, V _{GS} = 0)	ID(off)	_	0.5	μΑ
DYNAMIC CHARACTERISTICS	3				
Input Capacitance (V _{DS} = 10 V, V _{GS} = 0 V, f	= 1.0 MHz)	C _{iss}	_	60	pF
SWITCHING CHARACTERISTI	CS* QCENTSMM				
Turn-On Delay Time	(V _{DD} = 25 V, I _D = 500 mA, R _{gen} = 50 Ohms)	td(on)		10	ns
Turn-Off Delay Time	Figure 1	td(off)		10	

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

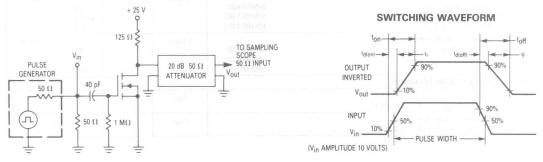


Figure 1. Switching Test Circuit

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	30	Vdc
Drain-Gate Voltage	V _{DG}	30	Vdc
Gate-Source Voltage	VGS	30	Vdc
Forward Gate Current	I _{G(f)}	50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	P _D	300	mW
Derate above 25°C		Vm 2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

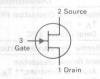
DEVICE MARKING

MMBF4391 = 6J; MMBF4392 = 6K; MMBF4393 = 6G

MMBF4391 thru MMBF4393

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)





JFET SWITCHING TRANSISTOR

N-CHANNEL

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Symbol		har neteristic			
Gate-Source Breakdown Voltage (I _G = 1.0 μAdc, V _{DS} = 0)		10. 200	V _(BR) GSS	30	COTEMBYON	Vdc
Gate Reverse Current $(V_{GS} = 15 \text{ Vdc}, V_{DS} = 0, T_A = 0)$ $(V_{GS} = 15 \text{ Vdc}, V_{DS} = 0, T_A = 0)$			IGSS	rsint, <u>Fi</u> arwae	1.0 0.20	nAdc μAdc
Gate Source Cutoff Voltage (V _{DS} = 15 Vdc, I _D = 10 nAdc)	(Atj35)/ (DS(on)	MMBF4391 MMBF4392	VGS(off)	4.0 2.0	10 5.0	Vdc
Au, 8.0 —	(Ro)DI	MMBF4393	10 = 2pV	0.5	3.0	On-State D
ON CHARACTERISTICS				sylcs	CILARACTER	
Zero-Gate-Voltage Drain (V _{DS} = 15 V, V _{GS} = 0)		MMBF4391 MMBF4392 MMBF4393	IDSS	50 25 5.0	150 75 30	mAdc
Drain Current (V _{DS} = 15 Vdc, V _{GS} = 12 Vdc) (V _{DS} = 15, V _{GS} = 12 Vdc, T _A		= 300 mX, Rigen < 50 Uninst Figure 1	D QP V ID	0 20 0 p us. D	1.0	nAdc μAdc
Drain-Source On-Voltage	SWIT	MMBF4391 MMBF4392 MMBF4393	V _{DS(on)}	V 25.7	0.4 0.4 0.4	Vdc
Static Drain-Source On Resistance ($I_D = 1.0 \text{ mAdc}, V_{GS} = 0$)	- 4e - no'	MMBF4391	rDS(on)	Suer -	30	Ohms
		MMBF4392 MMBF4393	12 00 48 50 12		100	PULSE CERTRAL CE
SMALL-SIGNAL CHARACTERISTIC	CS		PROMORDIA	-5-1	30 04 T	C to
Input Capacitance (VDS = 15 Vdc, VGS = 0, f = 1	.0 MHz)	-	C _{iss}		14	pF
Reverse Transfer Capacitance (VDS = 0, VGS = 12 Vdc, f = 1			C _{rss}	1001	3.5	pF

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	30	Vdc
Drain-Gate Voltage	V _{DG}	30	Vdc
Gate-Source Voltage	VGS	30	Vdc
Gate Current Spage 378 3840	IG	10	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^{\circ}C$	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stg}	150	°C

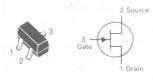
^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBF4416 = 6A

MMBF4416

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)



JFET
VHF/UHF AMPLIFIER TRANSISTOR
N-CHANNEL

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) And agricultural production of the control of th

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	•		POWERELLS	H
Gate-Source Breakdown Voltage (IG = 1.0 μ Adc, VDS = 0)	V _(BR) GSS	30	901-197 301 9	Vdc
Gate Reverse Current $(V_{GS} = 20 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = 20 \text{ Vdc}, V_{DS} = 0, T_A = 150^{\circ}\text{C})$	IGSS	_ 0 =	1.0 -	nAdc nAdc
Gate Source Cutoff Voltage (Ip = 1.0 nAdc, Vps = 15 Vdc)	VGS(off)	iolizin di	6.0	Vdc
Gate Source Voltage (I _D = 0.5 mAdc, V _{DS} = 15 Vdc)	VGS	1.0	5.5	Vdc
ON CHARACTERISTICS		10	E Vide Vigs	
Zero-Gate-Voltage Drain (VGS = 15 Vdc, VGS = 0)	IDSS	5.0	15	mAdc
Gate-Source Forward Voltage (IG = 1.0 mAdc, VpS = 0)	V _{GS(f)}	i sa <u>V</u> ar i	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS		10	ED NOT	
Forward Transfer Admittance (VDS = 15 Vdc, VGS = 0, f = 1.0 kHz)	Y _{fs}	4500	7500	μmhos
Output Admittance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 kHz)	Yos	on Tako	50	μmhos
Input Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	Ciss	_abde _ 1 _ab\	4.0	pF
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	C _{rss}	23/18/09	0.8	pF
Output Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	Coss	obj i -	2.0	pF
FUNCTIONAL CHARACTERISTICS				
Noise Figure (Vps = 15 Vdc, Ip = 5.0 mAdc, Rg \approx 1000 Ω , f = 100 MHz) (Vps = 15 Vdc, Ip = 5.0 mAdc, Rg \approx 1000 Ω , f = 400 MHz)	ir NF _{up} rij	aby gra	2.0 4.0	dB
Common Source Power Gain (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 100 MHz) (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 400 MHz)	(Gps(g)))	18 10	1-12-14 0 - 1 1-12-14 0 - 1	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Drain-Gate voltage	YDG	30	Vdc
Reverse Gate-Source Voltage	VGS(r)	30	Vdc
Forward Gate Current	IG(f)	50	mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{sta}	150	°C

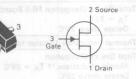
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBF4860 = 6F

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)





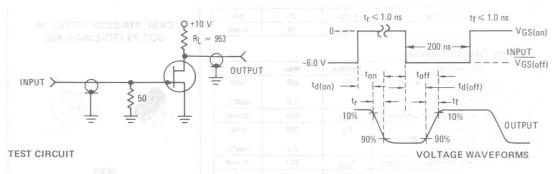
SWITCHING TRANSISTOR

N-CHANNEL DISAM BOWER

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) To seems 0'25 = 27 2017283TDARAND JACKYOLLS

Made Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			EDITERISTICS	AHO THO
Gate-Source Breakdown Voltage (IG = 1.0 µAdc, VDS = 0)	V(BR)GSS	30 10 /	se Bre <u>uk</u> down LuAdo, V os	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0) (VGS = 15 Vdc, VDS = 0, TA = 150°C)	IGSS	(0 = = 0, T _A = 1	20 0.5 20 2.0	nAdc µAdc
Gate Source Cutoff Voltage (V _{DS} = 15 Vdc, I _D = 0.5 nAdc)	VGS(off)	2.0 099 15 Vdc)	6.0 6.0	Vdc
ON CHARACTERISTICS			BgalloV st	Ječ stet
Zero-Gate-Voltage Drain(1) (V _{DS} = 15 Vdc, V _{GS} = 0)	IDSS	20	100	mAdc
Drain Cutoff Current (V _{DS} = 15 Vdc, V _{GS} = 10 Vdc) (V _{DS} = 15 Vdc, V _{GS} = 10 Vdc, T _A = 150°C)	ID(off)	- (0 -	0.25	nAdc μAdc
Drain-Source On-Voltage (I _D = 10 mAdc, V _{GS} = 0)	V _{DS(on)}	= 0) cremence	0.5	Vdc
Static Drain-Source On Resistance (VGS = 0, I _D = 0, f = 1.0 kHz)	rDS(on)	- 0.1 = 1.0	40	Ohms
Input Capacitance (V _{DS} = 0, V _{GS} = 10 Vdc, f = 1.0 MHz)	Ciss	0.1 = 1.0 =	18 and a	LA IPFIN
Reverse Transfer Capacitance (V _{DS} = 0, V _{GS} = 10 Vdc, f = 1.0 MHz)	C _{rss}	0.1 = 1.0 =	8.0	egeopE _{gr}
SWITCHING CHARACTERISTICS		lance	anster Capaci	r/ gavays
Delay Time (V _{DD} = 10 Vdc, I _{D(on)} = 20 mAdc) (V _{G(on)} = 0, V _{GS(off)} = 10 Vdc)	t _d Ishin	0.1 = 1.0 =	80 6.0 V 61	ens no regret
Rise Time (V _{DD} = 10 Vdc, I _{D(on)} = 10 mAdc) (V _{GS(on)} = 0, V _{GS(off)} = 6.0 Vdc) (Figure 1)	t _r	ERISTICS	5AR 4.0	or nsu
Turn-Off Time $(V_{DD} = 10 \text{ Vdc}, I_{D(on)} = 5.0 \text{ mAdc})$ $(V_{GS(on)} = 0, V_{GS(off)} = 4.0 \text{ Vdc})$ (Figure 1)	(SHEW COD - 1 D toffs -)	6.8 n ivi de, R Gain	S Ve 05 D	nomma

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.



NOTES: 1. The input waveforms are supplied by a generator with the following characteristics: $Z_{Out} = 50$ ohms, Duty Cycle $\approx 2.0\%$

2. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \le 0.75 \text{ ns}, \, R_{\text{in}} \ge 1.0 \text{ megohm}, \, C_{\text{in}} \le 2.5 \text{ pF}.$

MAXIMOM NATINGS			and the second
Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	25	Vdc
Drain-Gate Voltage	V _{DG}	25	Vdc
Reverse Gate-Source Voltage	VGS(r)	25	Vdc
Gate Current	IG I	10	mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C	- yl	1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, Tsta	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBF5457 = 6D

MMBF5457

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)





JFET
GENERAL PURPOSE TRANSISTOR

N-CHANNEL

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (I _G = 10 µAdc, V _{DS} = 0)	V _(BR) GSS	25	-	-	Vdc
Gate Reverse Current $(V_{GS} = 15 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = 15 \text{ Vdc}, V_{DS} = 0, T_A = 100^{\circ}\text{C})$	IGSS	Ξ	=	1.0 200	nAdc
Gate Source Cutoff Voltage (V _{DS} = 15 Vdc, I _D = 10 nAdc)	VGS(off)	0.5	_	6.0	Vdc
Gate Source Voltage (V _{DS} = 15 Vdc, I _D = 100 μ Adc)	VGS	-	2.5	_	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain(1) (V _{DS} = 15 Vdc, V _{GS} = 0)	IDSS	1.0	-	5.0	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance(1) (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 kHz)	Y _{fs}	1000	-	5000	μmhos
Reverse Transfer Admittance ($V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz}$)	Y _{rs}	_	10	50	μmhos
Input Capacitance ($V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ MHz}$)	C _{iss}	_	4.5	7.0	pF
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	C _{rss}	_	1.5	3.0	pF

⁽¹⁾ Pulse test: Pulse Width ≤ 630 ms; Duty Cycle ≤ 10%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit			
Drain-Gate Voltage	V _{DG}	56V 25	Vdc			
Reverse Gate-Source Voltage	V _{GS} (r)	obV −25	Vdc			
Gate Current	IG	10	mAdc			

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stg}	150	OB C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBF5459 = 6L

MMBF5459

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)





JFET TRANSISTOR

N-CHANNEL

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Gate-Source Breakdown Voltage $(I_G = -10 \mu A, V_{DS} = 0)$	V(BR)GSS	25	N - 2-) 12 1	Vdc
Gate 1 Leakage Current (VGS = -15 V, VDS = 0)	lG1SS	_	1.0	nA
Gate 2 Leakage Current (VGS = -15 V, VpS = 0, TA = 100°C)	IG2SS	<u></u>	200	nA
Gate Source Cutoff Voltage (V _{DS} = 15 V, I _D = 10 nA)	VGS(off)	2.0	8.0	Vdc
ON CHARACTERISTICS		17.617		
Zero-Gate-Voltage Drain (Vps = 15 V, Vgs = 0)	IDSS	4.0	16	mA
SMALL-SIGNAL CHARACTERISTICS		19	(9) T	
Forward Transfer Admittance (Vps = 15 V, V _{GS} = 0, f = 1.0 kHz)	Y _{fs}	2000	6000	μmhos
Output Admittance $(V_{DS} = 15 \text{ V, } V_{GS} = 0, f = 1.0 \text{ kHz})$	Yos		50	μmhos
Input Capacitance (Vps = 15 V, Vgs = 0, $f = 1.0 \text{ MHz}$)	Ciss	<u>, , 1</u> 0	7.0	pF
Reverse Transfer Capacitance ($V_{DS} = 15 \text{ V, } V_{GS} = 0, f = 1.0 \text{ MHz}$)	C _{rss}	9.1	3.0	pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

THE REAL PROPERTY AND ADDRESS OF THE PARTY AND	1 00 1		
Reverse Gate-Source Voltage	VGSR	6V 40	Vdc
Forward Gate Current	IGE	10	mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta,IA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBF5460 = 6E

WINDI STUU

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

P-CHANNEL

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) (TA = 25°C unless otherwise noted.)

tinti - matt	racteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				80	HSK3TDA	IAHO THO
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)	V(BR)GSS	V(BR)GSS	40		es B <u>re</u> akdev 10 "A. Vijis	Vdc
Gate Reverse Current (VGS = 20 Vdc, VDS = 0) (VGS = 20 Vdc, VDS = 0, TA = 1	100°C)	IGSS	=	(<u>0</u> = :	5.0	nAdc μAdc
Gate Source Cutoff Voltage (VDS = 15 Vdc, ID = 1.0 μ Adc)	Vestage	VGS(off)	0.75	AT 0 = s		Sate Sou
Gate Source Voltage (V _{DS} = 15 Vdc, I _D = 0.1 mAdc)		VGS	0.5	10 n <u>A</u>).	4.0	Vdc
ON CHARACTERISTICS	220			m	Veltage Dra	Zaro-Gale-
Zero-Gate-Voltage Drain (VDS = 15 Vdc, VGS = 0)		IDSS	1.0	OL_	5.0 MO JAME	mAdc
SMALL-SIGNAL CHARACTERISTICS	S (exy)			eonettii	ansler Adm	Forward T
Forward Transfer Admittance (VDS = 15 Vdc, VGS = 0, f = 1.0) kHz)	Y _{fs}	1000	1 = 10 =	4000	μmhos
Output Admittance (VDS = 15 Vdc, VGS = 0, f = 1.0) kHz)	Yos	Q 16H <u>281</u>] = <u>1</u> 0 =	30\75 ² aonsii:	μmhos
Input Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0) MHz)	C _{iss}	EHM 0	5.0	7.0	P P P P P P P P P P P P P P P P P P P
Reverse Transfer Capacitance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0)$) MHz)	C _{rss}	(<u>sel</u> Mi o	1.0	2.0	pF
Equivalent Short-Circuit Input Noise (Vps = 15 Vdc, Vgs = 0, Rg = $f = 100 \text{ Hz}$, BW = 1.0 Hz)		ē _n	-	20	-	nV/√Hz

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	25	Vdc
Reverse Gate-Source Voltage	V _{GS(r)}	25	Vdc
Forward Gate Current	I _G (f)	10	mAdc
Continuous Device Dissipation at or Below T _C = 25°C Linear Derating Factor	PD	200 2.8	mW mW/°C
Storage Channel Temperature Range	T _{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	ger mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C
Junction and Storage Temperature		1.11	

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

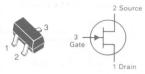
MMBF5484 = 6B

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage $(I_G = -1.0 \mu A, V_{DS} = 0)$		V _(BR) GSS	- 25	_	Vdc
Gate Reverse Current $(V_{GS} = -20 \text{ V}, V_{DS} = 0)$ $(V_{GS} = -20 \text{ V}, V_{DS} = 0, T_{A} = 100^{\circ}\text{C})$		IGSS		- 1.0 - 0.2	nA μA
Gate Source Cutoff Voltage (V _{DS} = 15 V, I _D = 10 nA)		VGS(off)	-0.3	-3.0	Vdc
ON CHARACTERISTICS			Contract (Contract	han street	
Zero-Gate-Voltage Drain (VDS = 15 V, VGS = 0)		IDSS	1.0	5.0	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance (V _{DS} = 15 V, V _{GS} = 0, f = 1.0 kHz)		Yfs	3000	6000	μmhos
Output Admittance (V _{DS} = 15 V, V _{GS} = 0, f = 1.0 kHz)		Yos	en T	50	μmhos
Input Capacitance (V _{DS} = 15 V, V _{GS} = 0, f = 1.0 MHz)		Ciss	N° 10 A ges	5.0	pF
Reverse Transfer Capacitance (V _{DS} = 15 V, V _{GS} = 0, f = 1.0 MHz)		C _{rss}		1.0	pF
Output Capacitance (Vps = 15 V, Vqs = 0, f = 1.0 MHz)		Coss	SI OT	2.0	pF
FUNCTIONAL CHARACTERISTICS		15	ele til t	ê.	
Noise Figure ($V_{DS} = 15 \text{ V}$, $I_{D} = 1.0 \text{ mA}$, $YG' = 1.0 \text{ mmhos}$) ($R_{G} = 1.0 \text{ k}\Omega$, $f = 100 \text{ MHz}$)		NF		2.0	dB
$(N_G = 1.0 \text{ kg}, T = 100 \text{ MHz})$ $(V_{DS} = 15 \text{ V}, V_{GS} = 0, Y_{GS} = 1.0 \mu\text{mho})$ $(R_G = 1.0 \text{ M}\Omega, f = 1.0 \text{ kHz})$			ECHTETTA	3.0 2.5	
Common Source Power Gain (V _{DS} = 15 Vdc, I _D = 1.0 mAdc, f = 100 MHz)	Rodent 0 1 = DY WHM I	G _{ps}	16	25	dB

MMBF5484

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)



JFET TRANSISTOR

N-CHANNEL

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit		
Drain-Gate Voltage	V _{DG}	25	Vdc		
Reverse Gate-Source Voltage	V _G S(r)	25	Vdc		
Forward Gate Current	IG(f)	10	mAdc		

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

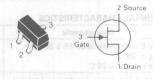
**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MMBF5486 = 6H

MMBF5486

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)



JFET TRANSISTOR

N-CHANNEL

Character	ristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (V _{DS} = 0, I _G = -1.0 μA)	(Jeston osiwnerite sest	V(BR)GSS	25 - 25	AL CHARAC	Vdc I
Gate 1 Leakage Current (VGS = -20 V, VDS = 0)	nye	IG1SS	_	-1.0 EXEMBTICS	nA MANU R
Gate 2 Leakage Current (VGS = -20 V, VDS = 0, TA = 100°C)	R8I [¥]	I _{G2SS}	emano V (0	-0.2	μΑ
Gate Source Cutoff Voltage (V _{DS} = 15 V, I _D = 10 nA)	D)	VGS(off)	-2.0	-6.0°	Vdc
ON CHARACTERISTICS			DI - 30 0	SOALA	50.0
Zero-Gate-Voltage Drain (VGS = 0, VDS = 15 V)	30%	IDSS	8.0 (A)	01 20 V	mA
SMALL-SIGNAL CHARACTERISTICS				SWITSHIRT D	AGAMO IN
Forward Transfer Admittance (VGS = 0, VDS = 15 V, f = 1.0 kHz)	0	Yfs	4000	8000	μmhos
Input Admittance (VGS = 0, VDS = 15 V, f = 400 MHz)	Α,	Re(yis)	95/NE	1000	μmhos
Output Admittance (VGS = 0, VDS = 15 V, f = 1.0 kHz)		Yos	NX 0.1 - 1.0	75 3008111	μmhos
Output Conductance (VGS = 0, VDS = 15 V, f = 400 MHz)		Re(yos)	VIII ().1 = 1.3	100	μmhos
Forward Transconductance (VGS = 0, VDS = 15 V, f = 400 MHz)	a	Re(yfs)	3500	nefer Capacit	μmhos
Input Capacitance $(V_{GS} = 0, V_{DS} = 15 \text{ V}, f = 1.0 \text{ MHz})$,a	C _{iss}	104 U.1 = 13	5.0	pF pF
Reverse Transfer Capacitance (VGS = 0, VDS = 15 V, f = 1.0 MHz)		C _{rss}	ENISTICS	1.0	pF
Output Capacitance (VGS = 0, VDS = 15 V, f = 1.0 MHz)		Coss	= "SY ,Am	2.0 LE = QL V 8	#8 pF
FUNCTIONAL CHARACTERISTICS		formu	Of a DV 4	1 = 20V V 2	Y = salV
Noise Figure (V _{DS} = 15 V, I _D = 4.0 mA, f = 100 MHz, '	$Y_G = 1.0 \mu mhos$	NF		2.0	dB
$(V_{DS} = 15 \text{ V}, I_{D} = 4.0 \text{ mA}, R_{G} = 1.0 \text{ k}\Omega, 10 \text{ m})$ $(V_{GS} = 0, V_{DS} = 15 \text{ V}, R_{G} = 1.0 \text{ m}\Omega, f = 1.0 \text{ m})$	$f = 400 \text{ MHz}, Y_G = 1.0 \mu \text{mhos})$	EHM oor -	0 mAdc, f	4.0 2.5	= 30V)
Common Source Power Gain (V _{DS} = 15 V, I _D = 4.0 mA, f = 100 MHz) (V _{DS} = 15 V, I _D = 4.0 mA, f = 400 MHz)		G _{ps}	18 10	30 20	dB

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Gate-Source Voltage	VGS	25	Vdc
Gate Current	IG	10	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBFJ310 = 6T

MMBFJ310

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)





JFET VHF/UHF AMPLIFIER TRANSISTOR

N-CHANNEL

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				National State	
Gate-Source Breakdown Voltage (I _G = -1.0 μAdc, V _{DS} = 0)	V _(BR) GSS	- 25	11111	_	Vdc
Gate Reverse Current $(V_{GS} = -15 \text{ V})$ $(V_{GS} = -15 \text{ V}, T_A = 125^{\circ}\text{C})$	IGSS	_	Ξ	- 1.0 - 1.0	nAdc μAdc
Gate Source Cutoff Voltage (V _{DS} = 10 Vdc, I _D = 1.0 nAdc)	VGS(off)	-2.0	T	- 6.5	Vdc
ON CHARACTERISTICS			* 10 MI		
Zero-Gate-Voltage Drain (V _{DS} = 10 Vdc, V _{GS} = 0)	IDSS	24	=	60	mAdc
Gate-Source Forward Voltage (I _G = 1.0 mAdc, V _{DS} = 0)	V _{GS(f)}	_	-	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS			TO STATE OF	2010	
Forward Transfer Admittance $(V_{DS} = 10 \text{ Vdc}, I_D = 10 \text{ mAdc}, f = 1.0 \text{ kHz})$	Yfs	8.0	HUR T ON I	18	mmhos
Output Admittance ($V_{DS} = 10 \text{ Vdc}$, $I_{D} = 10 \text{ mAdc}$, $f = 1.0 \text{ kHz}$)	Yos	<u>हिनस्</u> र	-	200	μmhos
Input Capacitance (VGS = -10 Vdc, VDS = 0 Vdc, f = 1.0 MHz)	C _{iss}	u= <u>=</u> 11	1 =	5.0	pF
Reverse Transfer Capacitance (VGS = -10 Vdc, VDS = 0 Vdc, f = 1.0 MHz)	C _{rss}	HW. IT	-	2.5	pF
Equivalent Short-Circuit Input Noise Voltage (V _{DS} = 10 Vdc, I _D = 10 mAdc, f = 100 Hz)	ē _n	m / 7.	10	-	nV/√Hz

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Drain-Source Voltage	VDS	25	Vdc
Gate-Source Voltage	VGS	25	Vdc
Gate Current	IG	10	mAdc

- Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C	N N	2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

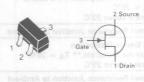
**Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

DEVICE MARKING

MMBFU310 = 6C

MMBFU310

CASE 318-02/03, STYLE 10 SOT-23 (TO-236AA/AB)



JFET CON TRANSISTOR

N-CHANNEL

	Charact	eristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					DISTRIBUTION	AMAID THE
Gate-Source Breakdown Voltage $(I_G = -1.0 \mu A, V_{DS} = 0)$	42-	SSD(RR)V	V _(BR) GSS	-25	gV Jabilu ().	Vdc
Gate 1 Leakage Current (VGS = -15 V, VDS = 0)		5591	I _{G1SS}	- covace	- 150	рА
Gate 2 Leakage Current (VGS = -15 V, VDS = 0, TA =	125°C)	VGS(off)	I _{G2SS}	aga 1.0 nAm)	- 150	nA
Gate Source Cutoff Voltage (VDS = 10 V, ID = 1.0 nA)			VGS(off)	- 2.5	6.0	Vdc
ON CHARACTERISTICS	2.5	280			nero sparo	
Zero-Gate-Voltage Drain (VDS = 10 V, VGS = 0)		Mest	IDSS	24	60	mA
Gate-Source Forward Voltage (IG = 10 mA, VDS = 0)			V _{GS(f)}	creas nes	1.0	Vdc
SMALL-SIGNAL CHARACTERISTIC	cs	latYI	relisi n. r.		C Vete In-	
Forward Transfer Admittance (VDS = 10 V, ID = 10 mA, f =	1.0 kHz)	laceVi	Y _{fs}	10	18	mmhos
Output Admittance (VDS = 10 V, ID = 10 mA, f =	1.0 kHz)	Ciss	lyosl	obV 0 = 5	150	μmhos
Input Capacitance (VGS = -10 V, VDS = 10 V, f	= 1.0 MH	(z) Gress	C _{iss}	Teonet	5.0	pF
Reverse Transfer Capacitance (VGS = -10 V, VDS = 10 V, f	= 1.0 MH	lz)	C _{rss}	Input Notes	2.5	pF

	CLU		
Collector-Base Voltage	VCBO	15	Vdc
Emitter-Base Voltage	VEBO	4.5	Vdc
Collector Current — Continuous	IC.	30	mA

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stg}	150	°C

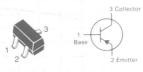
^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBR536 = 7R

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)

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HIGH FREQUENCY **TRANSISTOR**

PNP SILICON

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	1 samuo I				
Collector-Emitter Breakdown Voltage (I _C = 2.0 mA, I _B = 0)	V(BR)CEO	10	_	_	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μA, I _E = 0)	V(BR)CBO	15	_	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA, I _C = 0)	V(BR)EBO	4.5	-	_	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)	СВО		_	10	nAdo
ON CHARACTERISTICS					
DC Current Gain (I _C = 20 mA, V _{CE} = 5.0 V)	hFE	20	_	200	_
DYNAMIC CHARACTERISTICS	30	l 6			
(I _C = 20 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 GHz)	T frenchency	_	5.5	_	GHz
	and in serion Coin	P ⁻¹	0.8	1.2	pF
FUNCTIONAL TESTS	oupar i santos				
Gain (a Noise Figure	GNF				dB
CL	00 MHz	_	14	_	
f = 1	.0 GHz		8.0	-	
Noise Figure	NF				dB
CL	00 MHz		4.5	-	
f = 1	.0 GHz	_	6.0	_	

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

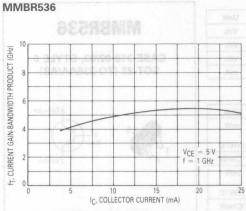


Figure 1. Current Gain-Bandwidth Product versus Collector Current

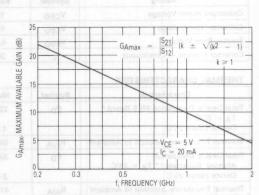


Figure 2. Maximum Available Gain (G_{Amax}) versus Frequency

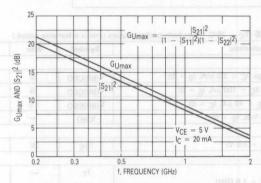


Figure 3. Maximum Unilateral Gain (G_{Umax}) and Insertion Gain (|S₂₁|²) versus Frequency

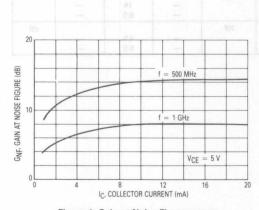


Figure 4. Gain at Noise Figure versus Collector Current

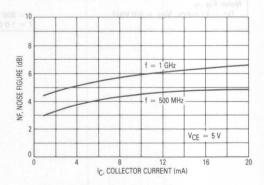


Figure 5. Noise Figure versus Collector Current

MMBR536

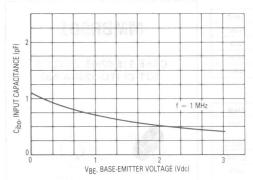


Figure 6. Input Capacitance versus Emitter-Base Voltage

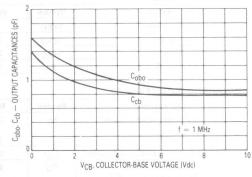
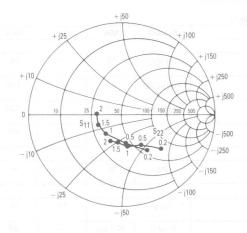


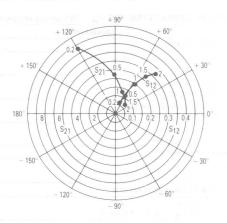
Figure 7. Output Capacitance versus Collector-Base Voltage

INPUT/OUTPUT REFLECTION COEFFICIENTS WAS ARREST OF THE PROPERTY OF THE PROPER

FREQUENCY V_{CE} = 10 V, I_C = 10 mA FORWARD AND REVERSE TRANSMISSION COEFFICIENTS versus

FREQUENCY $V_{CE} = 10 \text{ V}, I_{C} = 10 \text{ mA}$





COMMON EMITTER S-PARAMETERS

VCE	Ic	f	S	11	S	21 0 0000 0 12	S ₁	12	S	22
(Volts)	(mA)	(MHz)	S ₁₁	∠ φ	S ₂₁	∠ φ	S ₁₂	<i>Δ</i> φ	S ₂₂	∠ φ
10	5	200	0.60	-44	6.47	126	0.07	66	0.68	- 35
		500	0.37	-70	3.57	97	0.14	60	0.48	-50
		1000	0.27	- 105	2.16	74	0.22	53	0.40	- 69
		1500	0.24	- 138	1.62	58	0.29	46	0.37	-87
		2000	0.22	- 166	1.38	44	0.33	42	0.34	- 103
	10	200	0.48	- 54	8.65	120	0.06	66	0.58	- 40
		500	0.30	- 82	4.32	94	0.12	62	0.38	- 58
		1000	0.24	- 122	2.52	74	0.20	57	0.32	- 78
		1500	0.24	- 155	1.84	59	0.27	51	0.30	-96
		2000	0.24	178	1.54	46	0.32	47	0.28	-112
	20	200	0.39	- 63	10.10	115	0.06	67	0.49	- 50
		500	0.25	- 94	4.77	91	0.11	65	0.32	- 65
		1000	0.24	- 136	2.72	73	0.19	60	0.27	- 84
		1500	0.24	- 167	1.96	58	0.26	54	0.26	- 102
		2000	0.26	168	1.63	46	0.32	50	0.25	- 119

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Base Voltage	VCBO	25	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	Ic	30	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	P _D	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBR901 = 7A

MMBR901

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF AMPLIFIER TRANSISTOR

NPN SILICON

		Cha	racteristic			Symbol		Min	Max	Unit
OFF CHARACT	TERISTICS		-26				A	1		
Collector-Emit		n Voltage	\$	150		OCI -	V(BR)CEO	15	<- \	Vdc
Collector-Base		Voltage	27/1		000	DA	V(BR)CBO	25	-	Vdc
Emitter-Base E							V(BR)EBO	2.0	-	Vdc
Collector Cuto (V _{CB} = 15 V	The second second second	= 0)					СВО	1/2/	50	nAdo
ON CHARACT	ERISTICS	X	XIII	XV.	061	1-10		701	1	701-
DC Current Gain ($I_C = 5.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$)				hFE	30	200	_			
SMALL-SIGNA	AL CHARACT	ERISTICS	The I			00	1-		100	
Output Capaci (V _{CB} = 10 V	tance /dc, l _E = 0, f	= 1.0 MHz)		C _{obo}				102 -	1.0	pF
Common-Emit	ter Amplifier Vdc, I _C = 5.0						G _{pe} (1)	16 (Typ)	-	dB
Noise Figure	Adc, V _{CF} = 6	6.0 Vdc, f =	1.0 GHz)	OMMON EMITTER S PARAMETI				-	1.9 (Typ)	dB
) Noise figure							118			BaV

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	VCEO	15	Vdc	
Collector-Base Voltage	VCBO	20	Vdc	
Emitter-Base Voltage	VEBO	3.0	Vdc	
Collector Current — Continuous	IC	35	mAdd	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBR920 = 7B

MMBR920

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF AMPLIFIER/SWITCHING TRANSISTOR

NPN SILICON

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				i eggana.	
Collector-Emitter Breakdown Voltage $(I_C = 1.0 \text{ mAdc}, I_B = 0)$	V(BR)CEO	15			Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mAdc, I _E = 0)	V(BR)CBO	20	-	-	Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	V(BR)EBO	2.0	- -	, x —	Vdc
Collector Cutoff Current $(V_{CB} = 10 \text{ Vdc}, I_E = 0)$	ІСВО	_	_	50	nAdc
ON CHARACTERISTICS				mestro.	
DC Current Gain (I _C = 14 mAdc, V _{CE} = 10 Vdc)	hFE	25	_	250	_
SMALL SIGNAL CHARACTERISTICS		F. 31	HIE ONA		
Current-Gain — Bandwidth Product (IC = 14 mAdc, V _{CE} = 10 Vdc, f = 0.5 GHz)	fT	_	4.5	- I	GHz
Collector-Base Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$	C _{cb}	_		1.0	pF
Noise Figure (I _C = 2.0 mAdc, V _{CE} = 10 Vdc, f = 0.5 GHz) (I _C = 2.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 GHz)	NF(1)	1 (L) = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 =	2.4 3.0	_	dB
Common-Emitter Amplifier Power Gain (IC = 2.0 mAdc, VCE = 10 Vdc, f = 0.5 GHz) (IC = 2.0 mAdc, VCE = 10 Vdc, f = 1.0 GHz)	G _{pe} (1)		15 10	* *	dB

⁽¹⁾ Noise figure and power gain measured on the Ailtech 7380 50 Ω system.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	12 12	Vdc
Collector-Base Voltage	Vсво	15	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	Ic	35	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = 1.0 × 0.75 × 0.62 in.

DEVICE MARKING

MMBR930 = 7C

MMBR930

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





AMPLIFIER/SWITCHING **TRANSISTOR**

NPN SILICON

FLECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				83	REINST JAR	DHF CHIL
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	(88)V	V(BR)CEO	12	GV merobilis (G =	et aben ()	Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mAdc, I _E = 0)	(88)V	V(BR)CBO	15	Briov niwor (0 =	al abAm !	Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	(RB)V	V(BR)EBO	3.0	(0 =	ssa <u>Sre</u> akde 1 mAde; lig	Vdc
Collector Cutoff Current (V _{CB} = 5.0 Vdc, I _E = 0)	80(ІСВО			50	nAdc
ON CHARACTERISTICS				80	WC LEASE LE	ARS MO
DC Current Gain (I _C = 30 mAdc, V _{CE} = 5.0 Vdc)	ed .	hFE	25	s6V 0T = 3	250	. – OH HEANTO OC
SMALL-SIGNAL CHARACTERISTICS			531	RACTERIST	ICHAL GHA	LUAWE
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	ri e	C _{cb}	D 8.0 = 1	width Product of the state of t	1.0	pF
(IC = 2.0 mAdc, VCE = 5.0 Vdc, f = 0.5 GHz)		NF(1)	(eHM (1.9		dB
(I _C = 2.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 GHz)	DAM	0 (4)	120 - 12	2.5	W abAar 0	
Common-Emitter Amplifier Power Gain (IC = 2.0 mAdc, VCF = 5.0 Vdc, f = 0.5 GHz)		G _{pe} (1)			V abam 0	dB
(IC = 2.0 mAdc, VCE = 5.0 Vdc, f = 0.5 GHz)			reis O 1	8.0	nA retima	

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	VCEO	5.0	U. Vdc	
Collector-Base Voltage	VCBO	JbV 10	Vdc	
Emitter-Base Voltage	VEBO	2.0	□ A Vdc	
Collector Current — Continuous	Ic	obAm 5.0	○ mAdc	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 3 Wm1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBR931 = 7D

MMBR931

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF AMPLIFIER TRANSISTOR

NPN SILICON

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS INVIDENTIAL INVIDENTIA	olta	197.00 (DE 181.1 VIII)			
Collector-Emitter Breakdown Voltage (IC = 0.1 mAdc, IB = 0)	V(BR)CEO	5.0	v IIWebi	1248 3270	Vdc
Collector-Base Breakdown Voltage (IC = 0.01 mAdc, IE = 0)	V(BR)CBO	10		8 <u>u</u>	Vdc
Emitter-Base Breakdown Voltage (IE = 0.1 mAdc, IC = 0)	V _{(BR)EBO}	2.0	_		Vdc
Collector Cutoff Current $(V_{CB} = 5.0 \text{ Vdc}, I_{E} = 0)$	СВО			50	nAdc
ON CHARACTERISTICS					
DC Current Gain (IC = 0.25 mAdc, VCE = 1.0 Vdc)	hFE	30	Joseph Jan	150	_
SMALL-SIGNAL CHARACTERISTICS		111	150 V 100.		
Collector-Base Capacitance (VCB = 1.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{cb}	_		0.5	pF
Noise Figure (IE = 0.25 mAdc, V_{CE} = 1.0 Vdc, f = 1.0 GHz)	NF(1)	- 33	4.3	я ч. Тынг	dB
Gate Power Dissipation (IE = 0.25 mAdc, V _{CE} = 1.0 Vdc, f = 1.0 GHz)	PG(1)	1.0. [10		_

⁽¹⁾ Noise figure and power gain measured on the Ailtech 7380 50 Ω system.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	ph/ 30	0 d Vdc
Collector-Base Voltage	VCBO	55V 14	0 Vdc
Emitter-Base Voltage	VEBO	35V 4.0	0.5 Vdc
Collector Current — Continuous	Ic	shAm 50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max Max	Unit	10
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW	
Junction and Storage Temperature	T _J , T _{stg}	150	°C	

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBR2060 = 7E

MMBR2060

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF AMPLIFIER TRANSISTOR

NPN SILICON

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		wn Voltage	Mer Breakdo	Hector-f.in
Collector-Emitter Breakdown Voltage (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	14 apariov	Acc <u>la</u> = 6 e Brasidowe	Vdc
Collector Cutoff Current (VCB = 10 Vdc, IE = 0)	ІСВО	(0	50	nAdc
Emitter Cutoff Current (VEB = 4.0, IC = 0)	I _{EBO}	_	100	μAdc
ON CHARACTERISTICS			Vdc. Jg = 0	Vcg = 5.0
DC Current Gain (I _C = 5.0 mAdc, V _{CE} = 5.0 Vdc) (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 500 MHz)	hFE	20 2.0	TEMSTICS and — and — Veg	James L.
Collector-Emitter Saturation Voltage (I _C = 80 mAdc, I _B = 8.0 mAdc)	VCE(sat)	rentatios	0.38	Vdc
Base-Emitter Saturation Voltage (I _C = 40 mAdc, I _B = 20 mAdc)	V _{BE} (sat)	HM 07 = 1	0.98	Vdc
SMALL-SIGNAL CHARACTERISTICS	(ERE) 0.1	= 1,abV 0.1	r and ober	6 .0 = 3
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 1.0 Vdc, f = 100 MHz)	f _T	1.56V 0.1	1.0	GHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0$)	Ccb of Ccb	jein M eadure	1.0	pF _{i0}
Emitter-Base Capacitance ($V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0$)	C _{eb}	-	3.0	pF
Noise Figure $(V_{CE} = 10 \text{ Vdc}, I_{E} = 1.5 \text{ mAdc}, f = 450 \text{ MHz})$	NF(1)		3.5	dB
Common-Emitter Amplifier Power Gain $(V_{CE} = 10 \text{ Vdc}, I_E = 1.5 \text{ mAdc}, f = 450 \text{ Mhz})$	G _{pe} (1)	12.5	-	dB

⁽¹⁾ Noise figure and power gain measured on the Ailtech 7380 50 Ω system.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

	1 000	_	_
Emitter-Base Voltage	VEBO	2.5	Vdc
Collector Current — Continuous	IC	bAre 40	∪€ mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	Wm 225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	aa°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBR2857 = 7K

3 1 Base

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)

3 Collector

RF TRANSISTOR

NPN SILICON

Ch	aracteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	laimyd	31721 (9) 11 William			
Collector-Emitter Breakdown Voltage $(I_C = 3.0 \text{ mAdc}, I_B = 0)$	resiael	V(BR)CEO	15	NUMBER OF	Vdc
Concetor Base Breakdoviii Voltage	DE XEE V	V(BR)CBO	30	11-11	Vdc
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$	Оледічя)У	V(BR)EBO	2.5	7. 11.	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)	0.83	ICBO	— — ·	0.05	μAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 3.0 mAdc, V _{CE} = 1.0 Vdc)		hFE	30	2 1500	_
SMALL-SIGNAL CHARACTERISTICS			- 4.1%	371 370	
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f =	100 MHz)	fŢ	1000	ABAR <u>I</u> TIK	MHz
Collector-Base Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 0.1 \text{ MHz}$) ₅₅ 3	C _{cb}	<u></u>	1.0	pF
Small-Signal Current Gain (I _C = 2.0 mAdc, V _{CE} = 6.0 Vdc, f =	1.0 kHz)	h _{fe}	50	1 - 1	-
Noise Figure $(I_C = 1.5 \text{ mAdc}, V_{CE} = 6.0 \text{ Vdc}, R_S)$	= 50 Ω, f = 450 MHz)	NF	, bbs <u>n</u> u s	4.5	dB
Common-Emitter Amplifier Power Gair (I _C = 1.5 mAdc, V _{CF} = 6.0 Vdc, f =		GPE	12.5	56	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Wir Ottimotil Hirtinia			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30 30	Vdc
Collector-Base Voltage	VCBO	30 30	Vdc
Emitter-Base Voltage	VEBO	3.0	□ Vdc
Collector Current — Continuous	IC	30	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBR4957 = 7F

MMBR4957

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF AMPLIFIER TRANSISTOR

PNP SILICON

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		anglick roug	thyland hattie	To a street to
Collector-Emitter Breakdown Voltage $(I_C = 1.0 \text{ mAdc}, I_B = 0)$	V(BR)CEO	30	enteleccii ec	
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	V(BR)CBO	30	t = g l , ehAul	Vdc
Emitter-Base Breakdown Voltage (IE = $100 \mu Adc$, IC = 0)	V(BR)EBO	3.0	LAdo tte = 0	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _C = 0)	ІСВО	- (0.1	μAdc
ON CHARACTERISTICS			nis O	You make to
DC Current Gain (I _C = 2.0 mAdc, V _{CE} = 10 Vdc)	hFE		150	
SMALL-SIGNAL CHARACTERISTICS		th Product	n Bandwid	Colonarii
Current-Gain — Bandwidth Product (I _E = 2.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	isHfT 001	1,200	mAd a V gg	MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	C _{cb}		0.800	
Common-Emitter Amplifier Power Gain(1) (VCE = 10 Vdc, I _C = 2.0 mAdc, f = 450 MHz)	G _{pe}	17 (Typ)	a apv <u>-a</u> bAm	dB
Noise Figure(1) (I _C = 2.0 mAdc, V _{CE} = 10 Vdc, f = 450 MHz)	(sHM 02A = 1 (NF0 =)	6.0 Velo, Reserved	3.0 (Typ)	dB

⁽¹⁾ Noise figure and power gain measured on the Ailtech 7380 50 Ω system.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20V 10	Vdc
Collector-Base Voltage	VCBO	36V 15	○ Vdc
Emitter-Base Voltage	VEBO	3bV 3.0	Vdc
Collector Current — Continuous	Ic	uh Am 20	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	■ Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	V 417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBR5031 = 7G

MMBR5031

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF AMPLIFIER TRANSISTOR

NPN SILICON

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			C. HIMMI	F
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO	10	-	Vdc
Collector-Base Breakdown Voltage $(I_C = 0.01 \text{ mAdc}, I_E = 0)$	V(BR)CBO	15	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 0.01 \text{ mAdc}, I_C = 0$)	V(BR)EBO	3.0	TWO CO	Vdc
Collector Cutoff Current (V _{CB} = 6.0 Vdc, I _E = 0)	ІСВО	-	10	nAdd
ON CHARACTERISTICS			5 27 \ SIME I	
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 6.0 Vdc)	hFE	25	300	-
SMALL-SIGNAL CHARACTERISTICS		2012 2011		
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 6.0 Vdc, f = 100 MHz)	fT	1,000	nt san ter	MHz
Collector-Base Capacitance ($V_{CE} = 6.0 \text{ Vdc}$, $I_E = 0$, $f = 0.1 \text{ MHz}$)	C _{cb}	aumaini.	1.5	pF
Noise Figure (I _C = 1.0 mAdc, V_{CE} = 6.0 Vdc, f = 450 MHz)	NF(1)	I will die	2.5	dB
Common-Emitter Amplifier Power Gain (I _C = 1.0 mAdc, V _{CE} = 6.0 Vdc, f = 450 MHz)	G _{pe} (1)	14	25	qS

⁽¹⁾ Noise figure and power gain measure on Ailtech 7380 50 Ω system.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	aby 12	Vdc
Collector-Base Voltage	VCBO	20	Vdc Vdc
Emitter-Base Voltage	V _{EBO}	ab/ 2.5	Vdc
Collector Current — Continuous	Ic	50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 225 24 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	oc re

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

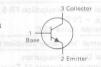
DEVICE MARKING

MMBR5179 = 7H

MMRR5179

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





RF AMPLIFIER TRANSISTOR

NPN SILICON

Ch	aracteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	1000000			POSTERIO TO	ose nea
Collector-Emitter Breakdown Voltage (I _C = 3.0 mAdc, I _B = 0)	C3O(88)V	V(BR)CEO	spaniov neve	nitter Breakdt	Vdc
Collector-Base Breakdown Voltage (I _C = 0.01 mAdc, I _E = 0)		V(BR)CBO	20 NOV 10	woodstate se	Vdc
Emitter-Base Breakdown Voltage (IE = 0.01 mAdc, IC = 0)	овакаву	V(BR)EBO	2.5	nwabiser8 s	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)		СВО		0.02	μAdc
ON CHARACTERISTICS				animalia vi	AL END NO
DC Current Gain (I _C = 3.0 mAdc, V _{CE} = 1.0 Vdc)		hFE	25	Gain -	Tremio OC
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		VCE(sat)	aorr ais mes	0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	T	V _{BE(sat)}	6.0 Vdc, f	1.0 Acr	Vdc
SMALL SIGNAL CHARACTERISTICS	69-7		90	se Capacitain	
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 6.0 Vdc, f =	100 MHz)	fT reside 626	900	and show	MHz
Collector-Base Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 0.1 \text{ to } 1)$	0 MHz)	C _{cb}	sD reword to	1.0	J no PF
Small Signal Current Gain (I _C = 2.0 mAdc, V _{CE} = 6.0 Vdc, f =	mintava (7 00	ossi _{Apal} hfe _{Ao an}	25	ewoo bus en	Noise figu
Noise Figure (I _C = 1.5 mAdc, V_{CE} = 6.0 Vdc, R _S	= 50 Ω , f = 200 Mhz)	NF(1)		4.5	dB
Common-Emitter Amplifier Power Gai (VCE = 6.0 Vdc, IC = 5.0 mAdc, f =		Gpe(1)	15	P. G	dB

⁽¹⁾ Noise figure and power gain measured on the Ailtech 7380 50 Ω system.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rati	ng	Symbol	Value	Unit
Forward Current Avg.	$(T_C = +67^{\circ}C)$	IF 1	510	mA
Peak Forward Gate Vo	oltage	VGFM	5.0	V
Peak Forward Blockin RG = 1.0 k	MMBS5060 MMBS5061	VFXM	30 60 100	V

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{sta}	150	°C

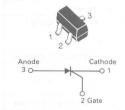
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBS5060 = 5R; MMBS5061 = 5S; MMBS5062 = 5T

MMBS5060 MMBS5061 MMBS5062

CASE 318-02/03, STYLE 14 SOT-23 (TO-236AA/AB)



SILICON CONTROLLED RECTIFIER
PNPN DEVICE

Character	istic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			managed to	and the	
Gate Trigger Voltage $(R_L = 100~\Omega,~R_{GC} = 1.0~k\Omega,~And~T_C = 125^{\circ}C)$	MMBS5060 = 30 V ode Voltage = MMBS5061 = 60 V MMBS5062 = 100 V	V _{GNT}	0.1	-	V
Peak Forward Blocking Current ($R_{GC} = 1.0 \text{ k}\Omega$, $T_{C} = 125^{\circ}\text{C}$)	V _{FXM} = MMBS5060 = 30 V MMBS5061 = 60 V MMBS5062 = 100 V	IFXM	_	50	μΑ
Peak Reverse Blocking Current (R _{GC} = 1.0 kΩ, T _C = 125°C)	V _{RXM} = MMBS5060 = 30 V MMBS5061 = 60 V MMBS5062 = 100 V	IRXM	_	50	μΑ
Forward Voltage* (I _F = 1.2 A Peak)	-083	VF	_	1.7	V
Gate Trigger Current** $(R_{GC} = 1.0 \text{ k}\Omega, V_{AC} = 7.0 \text{ V}, R_{L} = 100 \Omega$	963	lGT.		200	μА
Gate Trigger Voltage $(R_{GC} = 1.0 \text{ k}\Omega, V_{AC} = 7.0 \text{ V}, R_L = 100 \Omega)$	par M	VGT		0.8	V
Holding Current $(V_{AC} = 7.0 \text{ V}, R_{GC} = 1.0 \text{ k}\Omega)$	V "Etsay	lн		5.0	mA

^{*}PW ≤ 1.0 ms, D.C. ≤ 1.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

^{**}RGC current not included in measurement.

		Va	5)	
Rating	Symbol	404	404A	Unit
Collector-Emitter Voltage	VCEO	24	35	Vdc
Collector-Base Voltage	VCBO	25	40	Vdc
Emitter-Base Voltage	VEBO	12	25	Vdc
Collector Current — Continuous	lc	1	50	mAdo

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBT404 = 2M; MMBT404A = 2N

MMBT404 MMBT404A

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





3 Collector

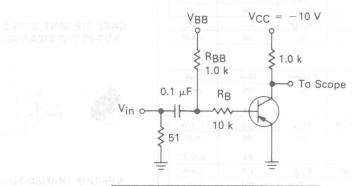
CHOPPER TRANSISTOR

PNP SILICON

Cha	aracteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	toomys		30150	Charactal			
Collector-Emitter Breakdown Voltag (I _C = 10 mAdc, I _B = 0)	TMOV	MMBT404 MMBT404A	V(BR)CEO	24	.0±0.r	Voltage O Lagare	
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	Wildl	MMBT404 MMBT404A	V _(BR) CBO	25 40	Currant	c) rd B <u>la</u> dicing 0 k <u>O</u>	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	-MXA ^j	MMBT404 MMBT404A	V(BR)EBO	12 25	Qureant	e B <u>ind</u> ding .0 k <u>Ou</u>	Vdc
Collector Cutoff Current (VCB = 10 Vdc, I _E = 0)	ąV	A 601 = Rendeplant	ІСВО		_	100	nAdc
Emitter Cutoff Current (V _{BE} = 10 Vdc, I _C = 0)	Tal		IEBO	-	_	100	nAdc
ON CHARACTERISTICS				12.001 =	PLY DV =	DWA TIN OF	- 595
DC Current Gain (I _C = 12 mAdc, V _{CE} = 0.15 Vdc)	TOV		hFE	0 30	= 7.0 V, PL	400	RGC =
Collector-Emitter Saturation Voltag (I _C = 12 mAdc, I _B = 0.4 mAdc) (I _C = 24 mAdc, I _B = 1.0 mAdc)	e		VCE(sat)		_ 08 0.F =	0.15 0.20	Vdc
Base-Emitter Saturation Voltage (I _C = 12 mAdc, I _B = 0.4 mAdc) (I _C = 24 mAdc, I _B = 1.0 mAdc)			V _{BE} (sat)	Jugmen	Dealth at tipt	0.85 1.0	Vdc
SMALL-SIGNAL CHARACTERISTIC	S						
Output Capacitance (V _{CB} = 6.0 Vdc, I _E = 0)			C _{obo}	-	-	20	pF
SWITCHING CHARACTERISTICS							
Delay Time $(V_{CC} = 10 \text{ Vdc}, I_{C} = 10 \text{ mAdc})$ (Figure 1)		^t d	_	43		ns
Rise Time $(I_{B1} = 1.0 \text{ mAdc}, V_{BE(off)} = 14 \text{ mag})$	Vdc)		t _r	-	180		ns
Storage Time $(V_{CC} = 10 \text{ Vdc}, I_{C} = 10 \text{ mAdc})$			t _S		675		ns
Fall Time (I _{B1} = I _{B2} = 1.0 mAdc) (Figure 1	1)		tf	-	160	-	ns

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

FIGURE 1 — SWITCHING TIME TEST CIRCUIT



	V _{in} (Volts)	V _{BB} (Volts)
ton, td, tr	- 12	+ 1.4
toff, t _S and t _f	+ 20.6	-11.6

Voltages and resistor values shown are for $I_C = 10$ mA, $I_C/I_B = 10$ and $I_{B1} = I_{B2}$

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	Ic	350	mAdo

THERMAL CHARACTERISTICS

Symbol	Max	Unit
PD	225	mW
	1.8	mW/°C
$R_{\theta JA}$	556	°C/mW
PD	300	mW
	2.4	mW/°C
$R_{\theta JA}$	417	°C/mW
TJ, Tstg	150	°C
	P _D R _θ JA P _D R _θ JA	P _D 225 1.8 R _θ JA 556 P _D 300 2.4 R _θ JA 417

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT918 = 3B

MMBT918

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





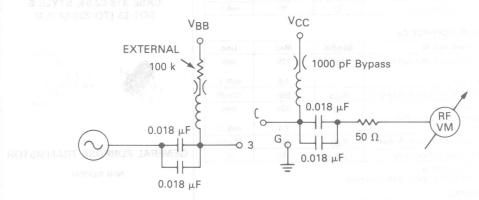
VHF/UHF TRANSISTOR

NPN SILICON

Characteristic and both of a ploal A	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (IC = 3.0 mAdc, IB = 0)	V(BR)CEO	15	_	Vdc
Collector-Base Breakdown Voltage (IC = 1.0 μ Adc, IE = 0)	V(BR)CBO	30	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	3.0	-	Vdc
Collector Cutoff Current $(V_{CB} = 15 \text{ Vdc}, I_E = 0)$	ICBO	_	50	nAdc
ON CHARACTERISTICS				1
DC Current Gain (I _C = 3.0 mAdc, V _{CE} = 1.0 Vdc)	hFE	20	-	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)	-	0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}		1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	600	-	MHz
Output Capacitance ($V_{CB} = 0$ Vdc, $I_E = 0$, $f = 1.0$ MHz) ($V_{CB} = 10$ Vdc, $I_E = 0$, $f = 1.0$ MHz)	C _{obo}	=	3.0 1.7	pF
Input Capacitance $(V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$	C _{ibo}	-	2.0	pF
Noise Figure (IC = 1.0 mAdc, VCE = 6.0 Vdc, RS = 50 Ω , f = 60 MHz) (Figure 1)	NF	-	6.0	dB
Power Output (I _C = 8.0 mAdc, V _{CB} = 15 Vdc, f = 500 MHz)	Pout	30	-	mW
Common-Emitter Amplifier Power Gain (IC = 6.0 mAdc, VCB = 12 Vdc, f = 200 MHz)	Gpe	11	_	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

FIGURE 1 — NF, Gpe MEASUREMENT CIRCUIT 20-200



NF Test Conditions

 $I_C = 1.0 \text{ Amp}$

V_{CE} = 6.0 Volts

 $R_S = 50 \Omega$

f = 60 MHz

Gpe Test Conditions

 $I_C = 6.0 \text{ mA}$

 $V_{CE} = 12 \text{ Volts}$ f = 200 MHz

MAXIMOM NATINGO			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	V _{CBO}	45	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	30	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	a PD 00	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	g mW
Derate above 25°C	1 11	2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBT930 = 1X

- MMBT930

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	0 = 1			
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, Ig = 0)	V(BR)CEO	45	-	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_F = 0)$	V(BR)CBO	45	-	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0) SHM 00	V/DD/CDO	5.0	-	Vdc
Collector Cutoff Current ($V_{CE} = 5.0 \text{ Vdc}, I_B = 0$)	ICEO	_	10	nAdc
Collector Cutoff Current $(V_{CB} = 45 \text{ Vdc}, I_{E} = 0)$	СВО	_	10	nAdc
Collector Cutoff Current (V _{CE} = 45 Vdc, V _{BE} = 0)	ICES		10	nAdc
Emitter Cutoff Current (VEB = 5.0 Vdc , IC = 0)	IEBO	-	10	nAdc
ON CHARACTERISTICS				
DC Current Gain (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 500 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	hFE	100 150	300	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc)	VCE(sat)	_	1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc)	V _{BE} (sat)	0.6	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 500 µAdc, V _{CE} = 5.0 Vdc, f = 30 MHz)	fT	30	-	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo}	_	8.0	pF
Noise Figure (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 k Ω , f = 10 Hz to 15.7 kHz)	NF		3.0	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	MMBT2222	MMBT2222A	Unit
Collector-Emitter Voltage	VCEO	30	40	Vdc
Collector-Base Voltage	VCBO	60	75	Vdc
Emitter-Base Voltage	V _{EBO}	5.0	6.0	Vdc
Collector Current — Continuous	Ic	6	00 00 1 1 10 10 10	mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

DEVICE MARKING

MMBT2222 = 1B; MMBT2222A = 1P

MMBT2222 MMBT2222A

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





TRANSISTOR

NPN SILICON

Refer to MPS2222 for graphs.

Characteristic	MINISTERIA	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	ASSS I BIVIVI	1375.N. L.			
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	MMBT2222 MMBT2222A	V(BR)CEO	30 40	=	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	MMBT2222 MMBT2222A	V(BR)CBO	60 75		Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \ \mu Adc, I_C = 0$)	MMBT2222 MMBT2222A	V(BR)EBO	5.0 6.0	Colonia I of	Vdc
Collector Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	MMBT2222A	ICEX		10	nAdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 125°C) (V _{CB} = 50 Vdc, I _E = 0, T _A = 125°C)	MMBT2222 MMBT2222A MMBT2222 MMBT2222A	MeAICBO		0.01 0.01 10	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0)	MMBT2222A	IEBO	_	10	nAdc
Base Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	MMBT2222A	IBL	_	20	nAdc
ON CHARACTERISTICS					
DC Current Gain $ \begin{aligned} &(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}) \\ &(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1) \\ &(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1) \\ &(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1) \end{aligned} $	MMBT2222A oniy MMBT2222 MMBT2222A	hFE	35 50 75 35 100 50 30 40	300	_
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	MMBT2222 MMBT2222A	VCE(sat)	_	0.4 0.3	Vdc
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$	MMBT2222 MMBT2222A		=	1.6 1.0	

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

ELECTRICAL CHARACTERISTICS (continued) (T _A = 25°C unless otherwise noted	.) 080*	
Characteristic	Symbol	Min

Characte	ristic	97 0	Symbol	Min	Max	Unit
Base-Emitter Saturation Voltage(1)			V _{BE(sat)}		agenov ea	Vdc
$(I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$		MMBT2222		snonum	1.3	
SOT-23 (TO-236AA/AB)		MMBT2222A		0.6	1.2	
(I _C = 500 mAdc, I _B = 50 mAdc)		MMBT2222		SULTEN	2.6	
		MMBT2222A	Todanis	_ 302	2.0	

SWALE-SIGNAL CHANACTERISTICS						Company Town
Current-Gain — Bandwidth Product(2) (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	DOWNER.	MMBT2222	fT	250	have 25°C costando Au	MHz
	Wm/3"	MMBT2222A	Alah Ingic	300	Service Control of the Control	1 13114-10714
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)			C _{obo}	7 _A = 28°C	8.0	pF
Input Capacitance	3.1991B	P.5	Cibo			pF
(VEB = 0.5 Vdc, IC = 0, f = 1.0 MHz)		MMBT2222	ALAR INSH	ration to Am	30	1 lamition
		MMBT2222A	otal st.T	anu)amourne	25	
Input Impedance (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (IC = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)		MMBT2222A MMBT2222A	h _{ie}		8.0 1.25	kΩ
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)		MMBT2222A MMBT2222A	h _{re}	- A <u>c</u> cctt	8.0 4.0	X 10-4
Small-Signal Current Gain		baton salwiarite need.	h _{fe}	OITERNATO	CAL DISARIA	H DELE
(I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)		MMBT2222A MMBT2222A	characteriatic	50 75	300 375	
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)		MMBT2222A MMBT2222A	h _{oe}	5.0 25	35 200	μmhos
Collector Base Time Constant (I _E = 20 mAdc, V _{CB} = 20 Vdc, f = 31.8 MHz)		MMBT2222A	rb'C _c	wn Veltage	150	ps
Noise Figure (I _C = 100 μ Adc, V _{CE} = 10 Vdc, R _S = 1.0 k Ω , f =	1.0 kHz)	MMBT2222A	NF	4.0	4.0	dB

SWITCHING CHARACTERISTICS MMBT2222A only

Delay Time	$(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc},$	t _d		10	ns
Rise Time	I _C = 150 mAdc, I _{B1} = 15 mAdc)	t _r	0100	25	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc,	t _S		225	ns
Fall Time	$I_{B1} = I_{B2} = 15 \text{ mAdc}$	tf	- in	60	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

⁽²⁾ f_T is defined as the frequency at which $|h_{\mbox{\scriptsize fe}}|$ extrapolates to unity.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Emitter Voltage	VCES	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.5	Vdc
Collector Current — Continuous	Ic	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{\mbox{\scriptsize A}} = 25^{\circ}{\mbox{\scriptsize C}}$ Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

DEVICE MARKING

MMBT2369 = 1J

MMBT2369

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





NPN SILICON

Refer to MPS2369 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic 2	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				100	
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO	15	- L	_	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu Adc$, $V_{BE} = 0$)	V(BR)CES	40	<u> </u>	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \ \mu Adc, I_E = 0$)	V(BR)CBO	40		7=-	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	4.5	_	-	Vdc
Collector Cutoff Current $(V_{CB} = 20 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 20 \text{ Vdc}, I_E = 0, T_A = 125^{\circ}\text{C})$	ІСВО	_		0.4	μAdc
ON CHARACTERISTICS					
DC Current Gain(1)	hFE	40 20 20		120 —	_
Collector-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)			0.25	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE} (sat)	0.70	TERROLLON	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_{E} = 0$, $f = 1.0 \text{ MHz}$)	C _{obo}		_	4.0	pF
Small Signal Current Gain ($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz}$)	h _{fe}	5.0	_	_	-
SWITCHING CHARACTERISTICS	20C Y/1 s= 1.1				
Storage Time $(I_{B1} = I_{B2} = I_{C} = 10 \text{ mAdc})$	t _S	_	5.0	13	ns
Turn-On Time ($V_{CC}=3.0~V_{dc}, I_{C}=10~mAdc, I_{B1}=3.0~mAdc)$	ton	_	8.0	12	ns
Turn-Off Time ($V_{CC}=3.0$ Vdc, $I_{C}=10$ mAdc, $I_{B1}=3.0$ mAdc, $I_{B2}=1.5$ mAdc)	^t off	_	10	18	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{*}FR-5 = 1.0 × 0.75 × 0.62 in. **Alumina = 0.4 × 0.3 × 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	60	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	P _D 225		mW	
Derate above 25°C		1.8	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** TA = 25°C	PD	300	mW	
Derate above 25°C		2.4	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW	
Junction and Storage Temperature	TJ, Tstg	150	°C	

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT2484 = 1U

MMBT2484

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





LOW NOISE TRANSISTOR

NPN SILICON

Refer to MPSA18 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) who shared 225 a ATI SOTTEMETOARAMO JACHTOELE

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			A CTERRISTICS	OFF OWN A
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, Ig = 0)	V(BR)CEO		nuter <u>P</u> reside NAdo, Ig = 1	
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO		nitter <u>Breakd</u> AAC, Vgg =	
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	5.0	ice Br eslidovi "Adc. Ig = 0	
Collector Cutoff Current (V _{CB} = 45 Vdc, I _E = 0) (V _{CB} = 45 Vdc, I _E = 0, T _A 150°C)	СВО	Voltage	10 10 10 10 10 10 10 10 10 10 10 10 10 1	
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO	T _A = 128'C		nAdc = 80V
ON CHARACTERISTICS			SOLEMBLICS	ON CHALLA
DC Current Gain (I _C = 1.0 mAdc, V_{CE} = 5.0 Vdc) (I _C = 10 mAdc, V_{CE} = 5.0 Vdc)	h _{FE}	250	H Bo¥LabAn	10 = 10 10 = 10 10 = 10
Collector-Emitter Saturation Voltage (I _C = 1.0 mAdc, I _B = 0.1 mAdc)	VCE(sat)	2.0 Vdcl on Voltage(1)	0.35	
Base-Emitter On Voltage (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	V _{BE} (on)	ta <u>u</u> Am G (Fingstlo	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS		(sbAm i)	T = BL,DDA	161 - 31
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1 MHz)	C _{obo}	5041 <u>8</u> 1831	6.0	pF D Hotel
Input Capacitance (VBE = 0.5 Vdc, I $_{\rm C}$ = 0, f = 1 MHz)	C _{ibo}	1.0 MHz	Current Sale	pF
Noise Figure (I _C = 10 μ Adc, V _{CF} = 5.0 Vdc, R _S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz)	NF	10 V <u>do</u> , F = 1 ISTROS	3.0	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

mirotimotili turtimoti				
Rating	Symbol	MPS2907	MPS2907A	Unit
Collector-Emitter Voltage	VCEO	40	nerito 60e mui	Vdc
Collector-Base Voltage	V _{CBO}	60		Vdc
Emitter-Base Voltage	VEBO	5	5.0	Vdc
Collector Current — Continuous	Ic	6	00	mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
	hot _		
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

 $\mathsf{MMBT2907} \,=\, \mathsf{2B}; \,\, \mathsf{MMBT2907A} \,=\, \mathsf{2F}$

MMBT2907 MMBT2907A

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to MPS2907 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteris	stic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) $(I_C = 10 \text{ mAdc}, I_B = 0)$	MMBT2907 MMBT2907A	V(BR)CEO	40 60	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V(BR)CBO	60	_	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)		V(BR)EBO	5.0	_	Vdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{BE(off)} = 0.5 Vdc)		ICEX	_	50	nAdd
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)	MMBT2907 MMBT2907A	СВО	=	0.020 0.010	μAdo
$(V_{CB} = 50 \text{ Vdc}, I_{E} = 0, T_{A} = 125^{\circ}\text{C})$	MMBT2907 MMBT2907A		_	20 10	
Base Current $(V_{CE} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc})$		IB	_	50	nAdd
ON CHARACTERISTICS					
DC Current Gain $(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MMBT2907 MMBT2907A	hFE	35 75	=	
(I _C = 1.0 mAdc, V_{CE} = 10 Vdc)	MMBT2907 MMBT2907A		50 100	_	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MMBT2907 MMBT2907A		75 100	_	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	MMBT2907, MMBT2907A		100	300	
(I _C = 500 mAdc, V_{CE} = 10 Vdc)(1)	MMBT2907 MMBT2907A		30 50	_	
Collector-Emitter Saturation Voltage(1) ($I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc}$)		VCE(sat)	_	0.4 1.6	Vdc
Base-Emitter Saturation Voltage(1) (IC = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)		V _{BE(sat)}	_	1.3 2.6	Vdc

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

	Characteristic			Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS		Vec	5.0	peak		agatloV e	and-restim
Current-Gain — Bandwidth Product(1),(2) (I _C = 50 mAdc, V _{CF} = 20 Vdc, f = 100 MHz)				frol	200	reolcon	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E	= 0, f = 1.0 MHz)			C _{obo}	30-T286	8.0	IAM pF
Input Capacitance (VBE = 2.0 Vdc, I _C = 0, f = 1.0 MHz)		Wes	225	Cibo	FR-5 Board,	30	pF
SWITCHING CHARA	CTERISTICS	DEWen	8.0			Bres evn	th state()
Turn-On Time		WentOT	836	ton to	sidmA us noit:	45	ns
Delay Time	$(V_{CC} = 30 \text{ Vdc}, I_{C} = 15 \text{ IB1} = 15 \text{ mAdc})$	0 mAdc,		an t _d	_	no 10	ns
Rise Time	IBT TO MINGO			tr	f _A = 25fC	40	ns
Turn-Off Time		3 (4411)	F-8	toff		100	ns
Storage Time $(V_{CC} = 6.0 \text{ Vdc}, I_{C} = 150 \text{ IB1} = I_{B2} = 15 \text{ mAdc})$		50 mAdc,		t _S	BIDITION OF HOME	80	ns
Fall Time	1B1 - 1B2 - 13 111Adc)			tf	a managed a	30	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ fT is defined as the frequency at which |hfe| extrapolates to unity.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	12	Vdc
Collector-Base Voltage	VCBO	Sec. 12	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	Ic	BA 80	mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225		
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	417 °C/mW	
Junction and Storage Temperature	TJ, T _{stg}	150	°C	

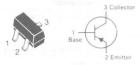
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT3640 = 2J

MMBT3640

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



SWITCHING TRANSISTOR

PNP SILICON

Refer to MPS3640 for graphs.

	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				8017111911	-7,
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)		V(BR)CES	12	strate and	Vdc
Collector-Emitter Sustaining Voltage(1) (I _C = 10 mAdc, I _B = 0)		VCEO(sus)	12	<u> </u>	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)		V(BR)CBO	12	10.18)(<u>= -</u> 11)	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)		V(BR)EBO	4.0	-	Vdc
Collector Cutoff Current (V	$V_{CE} = 6.0 \text{ Vdc}, V_{BE} = 0)$ $V_{CE} = 6.0 \text{ Vdc}, V_{BE} = 0, T_{A} = 65^{\circ}\text{C}$	CES	_	0.01	μAdc
Base Current (V _{CE} = 6.0)	Vdc , $V_{BE} = 0$)	lВ	10 T	10	nAdc
ON CHARACTERISTICS(1)	wast.				
DC Current Gain $(I_C = 10)$ $(I_C = 50)$	mAdc, V _{CE} = 0.3 Vdc) mAdc, V _{CE} = 1.0 Vdc)	hFE	30 20	120	
Collector-Emitter Saturation	$ \begin{array}{llllllllllllllllllllllllllllllllllll$	VCE(sat)	100201	0.2 0.6 0.25	Vdc
Base-Emitter Saturation Vo	itage (I _C = 10 mAdc, I _B = 0.5 mAdc) (I _C = 10 mAdc, I _B = 1.0 mAdc)	VBE(sat)	0.75 0.8 —	0.95 1.0 1.5	Vdc
SMALL SIGNAL CHARACT	ERISTICS		Sept 1.5		
Current-Gain — Bandwidth	Product ($I_C = 10 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 100 \text{ MHz}$)	fT	500	_	MHz
Output Capacitance (V _{CB} = = 5.0 Vdc, I _E = 0, f = 1.0 MHz)		C _{obo}	_	3.5	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MHz)		C _{ibo}	-	3.5	pF
SWITCHING CHARACTERIS	STICS				
	$(V_{CC} = 6.0 \text{ Vdc}, I_{C} = 50 \text{ mAdc}, V_{BE(off)} = 1.9 \text{ Vdc}, I_{B1} = 5.0 \text{ mAdc})$	td	PRATE A	10	ns
Rise Time		tr	es veitir la com	30	ns
Storage Time	$(V_{CC} = 6.0 \text{ Vdc}, I_{C} = 50 \text{ mAdc}, I_{B1} = I_{B2} = 5.0 \text{ mAdc})$	t _S	(4=-0.7)	20	ns
Fall Time		tf	66 <u>7</u> ,111	12	ns
Turn-On Time (V _{CC} = 6.0 Vdc, I _C = 50 (V _{CC} = 1.5 Vdc, I _C = 10	mAdc, $V_{BE(off)} = 1.9$ Vdc, $I_{B1} = 5.0$ mAdc) mAdc, $I_{B1} = 0.5$ mAdc)	ton	1.0g1 +1 0. <u>L</u> 2+1 0. <u>L</u> 2+1	25 60	ns
	mAdc, VBE(off) = 1.9 V, I _{B1} = I _{B2} = 5.0 mAdc) mAdc, I _{B1} = I _{B2} = 0.5 mAdc)	toff	201, 274,412 10, 3 2, 1 5, 41	35 75	ns

⁽¹⁾ Pulse Test: Pulse Width \leqslant 300 $\mu\text{s},$ Duty Cycle \leqslant 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

THE CONTRACTOR OF THE CONTRACT						
Rating	Symbol	Value	Unit			
Collector-Emitter Voltage	VCEO	36V 40	Vdc			
Collector-Base Voltage	VCBO	abV 60	Vdc			
Emitter-Base Voltage	VEBO	56V 6.0	Vdc			
Collector Current — Continuous	Ic	200	mAdc			

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	R _B JA	Vm 9 556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT3903 = 1Y; MMBT3904 = 1A

MMBT3903 MMBT3904

CASE 318-03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3903 for graphs.

tinU Max Unit	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					SOLEWIR LICE	STALED SHE
Collector-Emitter Breakdown Voltage((I _C = 1.0 mAdc, I _B = 0)	Vegeteset	ide, Vgg = 01 Addc, lp = 01	V(BR)CEO		nitter <u>B</u> resko nitter Sustalii	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_E = 0)$	Ово(яв)У	(0 = 9)	V(BR)CBO	60 V	eo B rai kdov	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	085(Hd) V		V _{(BR)EBO}	6.0	noff Current	Vdc
Base Cutoff Current (VCE = 30 Vdc, VEB = 3.0 Vdc)	el el	IV NO. AT	I _{BL}	20 Vdc. Vgg	50	nAdc
Collector Cutoff Current (VCE = 30 Vdc, VEB = 3.0 Vdc)	984		ICEX	19 mAde, Ve	50	nAdc
ON CHARACTERISTICS			(app. 0.1 = 10	SD made, V	= 90	
DC Current Gain(1) (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc)	VCE(sat)	MMBT3903 MMBT3904	Am OFE OF	20 40	alter Salura	3-mpalio
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		MMBT3903 MMBT3904	= 10 mAde, l = 10 mAde, l = 60 mAde, l	35 70	Sanumian	ettir 13-ses
(I _C = 10 mAdc, V _{CF} = 1.0 Vdc)		MMBT3903		50	150	MALL SM
500 - MHz			(IC = 10 made	100	300	mrgint Gal
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		MMBT3903 MMBT3904	1.0 = gl ob) 0.1 = 1.0 = g	30 60	Williamon (Vg itanon (Vg i CHARACVI	
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		MMBT3903 MMBT3904	08 = 51 abV 0.	15 30		emit yalı
Collector-Emitter Saturation Voltage($(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$ $(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$	1) 1 ¹ 2 ¹ 2 ¹ 2 ¹ 2 ¹	lobAm 0.8 = ggl = rgl .obAm l	VCE(sat)	8 = 3 <u>0</u> VI	0.2	Vdc
Base-Emitter Saturation Voltage(1) ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)	no ¹	(SnAm 0.8 = rgl of	VBE(sat)	0.65	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS	that				91	niT HOems
Current-Gain — Bandwidth Product ($I_C = 10 \text{ mAdc}$, $V_{CE} = 20 \text{ Vdc}$, $f = 10 \text{ mAdc}$		MMBT3903 MMBT3904		250 300	0 Vde, 1g = 5 Vdeu1g = Pulm Width	MHz

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic		03-	Symbol	Min	Max	Unit
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)			C _{obo}	10000	4.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MHz)			C _{ibo}	201 145	8.0	pF
Input Impedance (I _C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)		MMBT3903 MMBT3904	h _{ie}	1.0	8.0 10	k ohms
Voltage Feedback Ratio ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	y ywm Win 3r	MMBT3903 MMBT3904	h _{re}	0.1 0.5	5.0 8.0	X 10-4
Small-Signal Current Gain (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	Alm TuAm	MMBT3903 MMBT3904	h _{fe}	50 100	200 400	-
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)			h _{oe}	1.0	40	μmhos
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 1.0 k ohm f = 10 Hz to 15.7 kHz)	s,	MMBT3903 MMBT3904	NF		6.0 5.0	dB

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} = 3.0 Vdc, V _{BE} = 0.5 Vdc,	td	_	35	ns
Rise Time	I _C = 10 mAdc, I _{B1} = 1.0 mAdc)	t _r	oni a io.	35	ns
Storage Time	$(V_{CC} = 3.0 \text{ Vdc}, I_C = 10 \text{ mAdc}, MMBT3903 I_{B1} = I_{B2} = 1.0 \text{ mAdc}) MMBT3904$	t _s	_	175 200	ns
Fall Time		tf	_	50	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	200	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,*	PD	225	mW
T _A = 25°C Derate above 25°C	net -	1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	P _D	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

 $\mathsf{MMBT3906} = \mathsf{2A}$

Input Impedance

Voltage Feedback Ratio

Small-Signal Current Gain

 $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$

 $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$

($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, f = 1.0 kHz)

MMBT3906

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



Symbol

hie

hre

hfe

2.0

0.1

100

12

10

400

k ohms

X 10-4



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N3905 for graphs.

Min

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic

OFF CHARACTERISTICS				Cent Ties
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	40	nibiW eluf .	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	V _(BR) CBO	40		Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	-	Vdc
Base Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 3.0 Vdc)	IBL	_	50	nAdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 3.0 Vdc)	ICEX	_	50	nAdc
ON CHARACTERISTICS(1)				
DC Current Gain $ \begin{aligned} & (I_C = 0.1 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ & (I_C = 1.0 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ & (I_C = 10 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ & (I_C = 50 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ & (I_C = 100 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \end{aligned} $	hFE	60 80 100 60 30	300	_
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)	VCE(sat)	=	0.25 0.4	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)	VBE(sat)	0.65	0.85 0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fτ	250	-	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	_	4.5	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)	C _{ibo}	-	10.0	pF
				1

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{oe}	3.0	60	μmhos
Noise Figure (I _C = 100 μAdc, V _{CE} = 5.0 Vdc, R _S = 1.0 k ohm, f = 10 10 Hz to 15.7 kHz)	NF	Paritin'	4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} = 3.0 Vdc, V _{BE} = 0,5 Vdc	88 v	t _d		35	ns
Rise Time	I _C = 10 mAdc, I _{B1} = 1.0 mAdc)		tr	-	35	ns
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mAdc,		t _s	_	225	ns
Fall Time	$I_{B1} = I_{B2} = 1.0 \text{ mAdc}$	200	tf	_	75	ns

⁽¹⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	V
Collector-Base Voltage	VCBO	40	V
Emitter-Base Voltage	VEBO	5.0	V
Collector Current — Continuous	Ic	200	mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT4123 = 5B

MMBT4123

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N4123 for graphs.

$\textbf{ELECTRICAL CHARACTERISTICS} \; (T_{\mbox{\scriptsize A}} \; = \; 25^{\circ} \mbox{C unless otherwise noted.})$

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IE = 0)	V(BR)CEO	25	T	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	V(BR)CBO	30		Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0		Vdc
Collector Cutoff Current $(V_{CB} = 20 \text{ Vdc}, I_E = 0)$	ICBO		50	nAdc
Emitter Cutoff Current $(V_{BE} = 3.0 \text{ Vdc}, I_{C} = 0)$	IEBO	_	50	nAdc
ON CHARACTERISTICS				
DC Current Gain(1) $ (I_C = 2.0 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc)} $ $ (I_C = 50 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc)} $	hFE	50 25	150	_
Collector-Emitter Saturation Voltage(1) (IC = 50 mAdc, I _B = 5.0 mAdc)	VCE(sat)	-	0.3	Vdc
Base-Emitter Saturation Voltage(1) ($I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc}$)	V _{BE} (sat)	-	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	· f _T	250		MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	T	4.0	pF
Input Capacitance (VBE $= 0.5 \text{ Vdc}$, IC $= 0$, f $= 100 \text{ kHz}$)	C _{ibo}		8.0	pF
Collector-Base Capacitance (I _E = 0, V _{CB} = 5.0 V, f = 100 kHz)	C _{cb}		4.0	pF
Small-Signal Current Gain ($I_C = 2.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h _{fe}	50	200	_
Current Gain — High Frequency (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	h _{fe}	2.5		_
Noise Figure (IC = $100 \mu Adc$, $V_{CE} = 5.0 Vdc$, $R_S = 1.0 kohm$, Noise Bandwidth = $10 Hz$ to $15.7 kHz$)	NF		6.0	dB

⁽¹⁾ Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC	200	mAdc
Total Device Dissipation (α T _A = 25°C – Derate above 25°C	PD	350 2.8	mW mW/°C
Total Device Dissipation (α T _C = 25°C Derate above 25°C	PD	1.0 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{stg}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT4125 = 2D

MMBT4125

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N4125 for graphs.

Characteristic	112-00	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _E = 0)	laby A	V _(BR) CEO	30		Vdc
Collector-Base Breakdown Voltage (IC = 10 µAdc, IE = 0)	Paby Bill Shy N	V(BR)CBO	30	extra de	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	test (0.1 = 30 k of	V(BR)EBO	4.0	_	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)	2.0 Vdc	ІСВО	_	50	nAdc
Emitter Cutoff Current (V _{BE} = 3.0 Vdc, I _C = 0)	bbArr (6 = g) .50	IEBO		50	nAdc
ON CHARACTERISTICS					
DC Current Gain(1) (IC = 2.0 mAdc, VCE = 1.0 Vdc) (IC = 50 mAdc, VCE = 1.0 Vdc)		hFE	50 25	150	_
Collector-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)		VCE(sat)		0.4	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)		V _{BE(sat)}	_	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)		fT	200		MHz
Input Capacitance (VBE = 0.5 Vdc, IC = 0 , f = 100 kHz)		C _{ibo}	1 2-17	10	pF
Collector-Base Capacitance $(V_{CB} = 5.0 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$		C _{cb}	_	4.5	pF
Small-Signal Current Gain ($I_C = 2.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)		hfe	50	200	-
Current Gain — High Frequency (IC = 10 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)		h _{fe}	2.0	_	
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 1.0 kohm, Noise Bandwidth = 10 Hz to 15.7 kHz)		NF		5.0	dB

⁽¹⁾ Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	lc	600	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT4401 = 2X

MMBT4401

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N4401 for graphs.

ELECTRICAL CHARACTEI	RISTICS (TA = 25°C unless otherwise noted.)		Refer to 2N4	tor grapi	15.
	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown	Voltage(1) $(I_C = 1.0 \text{ mAdc}, I_B = 0)$	V(BR)CEO	40		Vdc
Collector-Base Breakdown Vo	oltage (I _C = 0.1 mAdc, I _E = 0)	V _(BR) CBO	60	RASEJ JA	Vdc
Emitter-Base Breakdown Vol-	tage (I _E = 0.1 mAdc, I _C = 0)	V(BR)EBO	6.0		Vdc
Base Cutoff Current (VCE =	35 Vdc, V _{EB} = 0.4 Vdc)	IBEV		0.1	μAdc
Collector Cutoff Current (Vo	ce = 35 Vdc, V _{EB} = 0.4 Vdc)	ICEX	ugstlov mao	0.1	μAdc
ON CHARACTERISTICS(1)	as convenient		anadaV m	wahunauli as	dan malin
DC Current Gain	(I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 150 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 2.0 Vdc)	hFE	20 40 80 100 40	300	(Ig= 10) mitter Base (Ig = 10) offector Co
	Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	VCE(sat)	_ 1	0.4 0.75	Vdc
Base-Emitter Saturation Volt	age $(I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$ $(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$	VBE(sat)	0.75	0.95 1.2	Vdc
SMALL-SIGNAL CHARACTE	RISTICS				manap3 1
Current-Gain — Bandwidth F $(I_C = 20 \text{ mAdc}, V_{CE} = 10)$		fT	250	BOV BBA	MHz
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f	= 100 kHz)	C _{cb}	labAm 0.6	6.5	pF
Emitter-Base Capacitance (V _{BE} = 0.5 Vdc, I _C = 0, f	= 100 kHz)	C _{eb}	(DDAm 0.6	30	pF
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 10) Vdc, f = 1.0 kHz)	h _{ie}	1.0	15 wbns6 — r	k ohm
Voltage Feedback Ratio (IC = 1.0 mAdc, VCE = 10) Vdc, f = 1.0 kHz)	h _{re}	0.1	8.0	X 10-
Small-Signal Current Gain (IC = 1.0 mAdc, VCE = 10	Vdc, f = 1.0 kHz)	hfe	40	500	eg octoálic a Bakh
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10	Vdc, f = 1.0 kHz)	h _{oe}	1.0	30	μmho
SWITCHING CHARACTERIS	rics	(SFISE 0.2); =	1,000.01	BOA Jobywa	0.8 < 38
	V _{CC} = 30 Vdc, V _{EB} = 2.0 Vdc,	td	SO Value E	15	ns
Rise Time	C = 150 mAdc, I _{B1} = 15 mAdc)	t _r	_	20	ns
	$V_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ mAdc},$	t _S	= 5.0 -Y do, R	225	or ns
Fall Time	$B_1 = I_{B2} = 15 \text{ mAdc}$	t _f	7.81 <u>pl</u> 5H (30	ns

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	V _{CBO}	40	Vdc
Emitter-Base Voltage	V _{EBO}	5.0	Vdc
Collector Current — Continuous	IC	600	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT4403 = 2T

MMBT4403

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N4402 for graphs.

	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				V	5 1.1
Collector-Emitter Breakdo	own Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO	40		Vdc
Collector-Base Breakdow	n Voltage (I _C = 0.1 mAdc, I _E = 0)	V(BR)CBO	40	_	Vdc
Emitter-Base Breakdown	Voltage ($I_E = 0.1 \text{ mAdc}, I_C = 0$)	V(BR)EBO	5.0		Vdc
Base Cutoff Current (Vo	ce = 35 Vdc, V _{BE} = 0.4 Vdc)	IBEV	_	0.1	μAdc
Collector Cutoff Current	(V _{CE} = 35 Vdc, V _{BE} = 0.4 Vdc)	ICEX	_	0.1	μAdc
ON CHARACTERISTICS					
DC Current Gain	(I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 150 mAdc, V _{CE} = 2.0 Vdc)(1) (I _C = 500 mAdc, V _{CE} = 2.0 Vdc)(1)	hFE	30 60 100 100 20	300	_
Collector-Emitter Saturat	ion Voltage(1) ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)	VCE(sat)	191 <u>2</u> 110	0.4 0.75	Vdc
Base-Emitter Saturation	Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	V _{BE} (sat)	0.75	0.95 1.3	Vdc
SMALL-SIGNAL CHARA	CTERISTICS			M. A. C. C. C.	
Current-Gain — Bandwidt	th Product ($I_C = 20 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 100 \text{ MHz}$)	fT	200	N D L	MHz
Collector-Base Capacitan	ce $(V_{CB} = 10 \text{ Vdc}, I_{E} = 0, f = 140 \text{ kHz})$	C _{cb}	<u> </u>	8.5	pF
Emitter-Base Capacitance	$V_{BE} = 0.5 \text{ Vdc, } I_{C} = 0, f = 140 \text{ kHz}$	Ceb		30	pF
Input Impedance (IC =	1.0 mAdc, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	hie	1.5k	15k	ohms
Voltage Feedback Ratio	$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	hre	0.1	8.0	X 10-4
Small-Signal Current Ga	in $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	h _{fe}	60	500	_
Output Admittance (IC	= 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	hoe	1.0	100	μmhos
SWITCHING CHARACTE	RISTICS			3116 275 (5.1)	-
Delay Time	(V _{CC} = 30 Vdc, V _{BE} = 2.0 Vdc,	t _d	1 12 04	15	ns
Rise Time	I _C = 150 mAdc, I _{B1} = 15 mAdc)	tr		20	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc,	ts	6 J .	225	ns
Fall Time	$I_{B1} = I_{B2} = 15 \text{ mAdc}$	tf	_	30	ns

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	ahV 50	Vdc
Collector-Base Voltage	VCBO	50	Vdc
Emitter-Base Voltage	VEBO	aby 3.0	Vdc
Collector Current — Continuous	Ic	50	mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 225 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Vm 2 417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT5086 = 2P; MMBT5087 = 2Q

MMBT5086 MMBT5087

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





LOW NOISE TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) with academ 3145 at AT 20172195TOARAMO LAS 13703.13

rint/ xsM niN CI	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	OBD(BB)V	nAdc. (g = 0)	V(BR)CEO	50	alter <u>Preside</u> ns se Bresideows	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	OBSINED	(0 = 3	V(BR)CBO	50	/ nwiolonses8 i	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0) (V _{CB} = 35 Vdc, I _E = 0)	V39 [[]	lobV I	ІСВО	36 = 40V	10	nAdc
ON CHARACTERISTICS	and l	Ado, Ves = 1.0 Ves	(let = 0.1 au		IT BE	Corrent C
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc)		MMBT5086 MMBT5087	# 0.1 hFE 0.1	150 250	500 800	_
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		MMBT5086 MMBT5087	(ig = 580 i	150 250	oirsrud ia ram	n i- totaslici
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		MMBT5086 MMBT5087	1 005 = 20 1 091 = 20	150 250	Saturation M	Jase-Emitte
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	int 1	V _{CE} = 10 VGC t = 100 MHz)	VCE(sat)	Product ()	0.3	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	G _{GB}	f = 140 kHz)	V _{BE(sat)}	= g ₂ V) =	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS	100	Intel A L	Laky (t) = =	st alsten 0	i w Nil san	boom! tues
Current-Gain — Bandwidth Product (I _C = 500 μ Adc, V _{CE} = 5.0 Vdc, f	= 20 MHz)	Vote, f = 1.0 kHz)	or = fTV.sb/	40	bsc/Repo (MHz
Output Capacitance (VCB = 5.0 Vdc, I _E = 0, f = 100 kH	lz)	(SHA 0.1 = 1.30 V 01 (SHA 0.1 = 1)	C _{obo}	obAm 0.1	4.0	pF A higher
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f		MMBT5086 MMBT5087	h _{fe}	150 250	600 900	SWITCHE (C
Noise Figure (I _C = 20 mAdc, V _{CE} = 5.0 Vdc, R _S	$=$ 10 k Ω ,	abAm (NF id = gi ,sev (sbAm 31 =	(Vcc = 30		dB
f = 10 Hz to 15.7 kHz)		MMBT5086 MMBT5087	= 16 made)	181 - 182 2 300 yas, Dr	3.0	all Time Pulse Tx cu
$(I_{C} = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, R_{S} = 3.0 \ k\Omega, f = 1.0 \ kHz)$		MMBT5086 MMBT5087		=	3.0	

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

	-	Va	Value		
Rating	Symbol	MMBT5088	MMBT5089	Unit	
Collector-Emitter Voltage	VCEO	30	25	Vdc	
Collector-Base Voltage	VCBO	35	30	Vdc	
Emitter-Base Voltage	VEBO	4	.5	Vdc	
Collector Current — Continuous	lc	MARKE E	60 (uCa	mAdo	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT5088 = 1Q; MMBT5089 = 1R

MMBT5088 MMBT5089

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



LOW NOISE TRANSISTOR

NPN SILICON

Refer to MPSA18 for graphs.

ELECTRICAL	CHARACTERISTICS	$(T_A =$	25°C unless otherwise noted.)
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C	haracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	lastings.		Dinamer-Space			
Collector-Emitter Breakdown Voltage ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	22 H 13 W	MMBT5088 MMBT5089	V(BR)CEO	30 25		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	080(85/V	MMBT5088 MMBT5089	V(BR)CBO	35 30		Vdc
Collector Cutoff Current (VCB = 20 Vdc, I _E = 0) (VCB = 15 Vdc, I _E = 0)	(Sept.	MMBT5088 MMBT5089	Ісво	_	50 50	nAdc
Emitter Cutoff Current (VEB(off) = 3.0 Vdc, I _C = 0) (VEB(off) = 4.5 Vdc, I _C = 0)		MMBT5088 MMBT5089	IEBO		50 100	nAdc
ON CHARACTERISTICS						
DC Current Gain ($I_C = 100 \mu Adc, V_C$	CE = 5.0 Vdc)	MMBT5088 MMBT5089	hFE	300 400	900 1200	_
$(I_C = 1.0 \text{ mAdc}, V_C)$	CE = 5.0 Vdc)	MMBT5088 MMBT5089		350 450	- 11 Gr	
$(I_C = 10 \text{ mAdc}, V_C)$	CE = 5.0 Vdc)	MMBT5088 MMBT5089		300 400	-	
Collector-Emitter Saturation Voltage	(I _C = 10 mAdc, I _B	3 = 1.0 mAdc)	V _{CE(sat)}	- <u> </u>	0.5	Vdc
Base-Emitter Saturation Voltage (IC	= 10 mAdc, I _B =	1.0 mAdc)	V _{BE(sat)}	311.71	0.8	Vdc
SMALL SIGNAL CHARACTERISTICS				31-0-34	river sc	
Current-Gain — Bandwidth Product (I _C = 500 μ Adc, V _{CE} = 5.0 Vdc, f	= 20 MHz)		fT	50		MHz
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kH	dz emitter guarded)		C _{cb}		4.0	pF
Emitter-Base Capacitance $(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$	dz collector guarded	d)	C _{eb}	_	10	pF
Small Signal Current Gain (I _C = 1.0 mAdc, V_{CE} = 5.0 Vdc, f	= 1.0 kHz)	MMBT5088 MMBT5089	h _{fe}	350 450	1400 1800	
Noise Figure ($I_C = 100 \mu Adc$, $V_{CE} = 5.0 Vdc$, Ref = 10 Hz to 15.7 Hz)	$S = 10 \text{ k}\Omega,$	MMBT5088 MMBT5089	NF	_	3.0 2.0	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Collector-Base Voltage	VCBO	160	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic and	500	mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C	I VA	2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBT5401 = 2L

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





HIGH VOLTAGE TRANSISTOR

PNP SILICON

Refer to 2N5401 for graphs.

C	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	nances V			down Voltage	mitter Brekke	i notoellul
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)		BBOSTEIMM GROSTEIMM	V(BR)CEO	150		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	OBS(RS)V	MMeTages	V(BR)CBO		obserte nasi e glabbau 0	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μ Adc, I _C = 0)	ogol	Bootewa	V(BR)EBO	5.0	Inemus Tiche	Vdc
Collector Cutoff Current (V _{CB} = 100 Vdc, I _E = 0)		BECG FEWINA BECG FEWINA	ІСВО	(0	50 50	nAdc
(V _{CB} = 100 Vdc, I _E = 0, T _A = 150	J°C) CEE	(SDSTBMM		10 - 0	50	μAdc
ON CHARACTERISTICS		REDSTRIMM		(0 = 5	- 4.5.Vdc_i	(VEBICE)
DC Current Gain (IC = 1.0 mAdc, VCF = 5.0 Vdc)			hFE	50	ROTERISTO.	HANDHAO
(I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc) (I _C = 50 mAdc, V _{CE} = 5.0 Vdc)			GE = 5.0 Vdc	60 50	240	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)		BS08T8WM- EB03T8WM	VCE(sat)	1.0 mAde, V	0.20 0.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)			VBE(sat)	10 mAdic, V	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	(ase)30V	= 1.0 made) 5 mådel		7/4		
Current-Gain — Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f =	- danight	(SPAR) (I	fT		300	
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MI	Hz)		Cobo	= 5.0 Vdc, f	6.0	0 = pF
Small Signal Current Gain $(I_C = 1.0 \text{ mAdc, } V_{CE} = 10 \text{ Vdc, } f$	= 1.0 kHz)		ibabiling the na sk	× 00140 1.0	200	= 8 51 (1
Noise Figure (I _C = 200 µAdc, V _{CE} = 5.0 Vdc, R f = 10 Hz to 15.7 kHz)	S = 10 ohms,		ibetusup 101NF ₁₀₀ si	0, F = 1.00 ld	8.0	dB dB
f = 10 Hz to 15.7 KHz)	9111	Shigas shifte	13/13/0.1	1,00V 0.8 -	3.17 1270	16-10

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	140	Vdc
Collector-Base Voltage	VCBO	160	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	600	mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT5550 = 1F; MMBT5551 = G1

MMBT5550 MMBT5551

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





HIGH VOLTAGE TRANSISTOR

NPN SILICON

Refer to 2N5550 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit	
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(2) (IC = 1.0 mAdc, IB = 0)	MMBT5550 MMBT5551	V(BR)CEO	140 160		Vdc	
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	MMBT5550 MMBT5551	V(BR)CBO	160 180	= ,	Vdc	
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	6.0	- N - 1	Vdc	
Collector Cutoff Current (V _{CB} = 100 Vdc, I _E = 0) (V _{CB} = 120 Vdc, I _E = 0) (V _{CB} = 100 Vdc, I _E = 0, T _A = 100°C) (V _{CB} = 120 Vdc, I _E = 0, T _A = 100°C)	MMBT5550 MMBT5551 MMBT5550 MMBT5551	ІСВО	_ _ _	100 50 100 50	nAdc μAdc	
Emitter Cutoff Current (V _{EB} = 4.0 Vdc, I _C = 0)		IEBO		50	nAdc	
ON CHARACTERISTICS(2)						
DC Current Gain (IC = 1.0 mAdc, $V_{CE} = 5.0 \text{ Vdc}$)	MMBT5550 MMBT5551	hFE	60 80		_	
(I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	MMBT5550 MMBT5551 MMBT5550 MMBT5551		60 80 20 30	250 250		
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	Both Types	VCE(sat)	ROMENIA D	0.15	Vdc	
$(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$	MMBT5550 MMBT5551		-	0.25 0.20		
Base-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)	Both Types MMBT5550	VBE(sat)	1000 (E)	1.0	Vdc	
	MMBT5551		_	1.0		

(2) Pulse Test: Pulse Width $\,=\,300~\mu s$, Duty Cycle $\,=\,2.0\%$.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	12	Vdc
Collector Current — Continuous	Ic	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

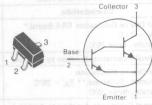
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT6427 = 1V

MMBT6427

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N6426 for graphs.

rint! xafM miM Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					ACTERISTICS	OFF DELIKE
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	ово(яв)Ч	оссатимм	V _(BR) CEO		nitroi <u>P</u> resint n'Ada, 18 ×	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	OBSTREET	Page Luterin	V _(BR) CBO	40 spanov m	se Breakdow	Vdc
Emitter-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_C = 0$)		1ageTaMM	V _{(BR)EBO}	12	3-3	Vdc
Collector Cutoff Current (V _{CE} = 25 Vdc, I _B = 0)	VIBRIEBO		ICEO	9861104	1.0	μAdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	1080	MMRTBSSS	ICBO	10	50	nAdc
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)		nastration 13asCsiviti	IEBO (3)	$0, T_A = 100$ $0, T_A = 100$	50 / 10	nAdc
ON CHARACTERISTICS						
DC Current Gain $(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ $(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ $(I_C = 500 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$			hFE	10,000 20,000 14,000	100,000 200,000 140,000	ON CHAP.
Collector-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 0.5 mAdc) (I _C = 500 mAdc, I _B = 0.5 mAdc)		MMarses	VCE(sat)	5,0 V 46)	1.2	Vdc
Base-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 0.5 mAdc)		reastema.	V _{BE} (sat)		2.0	Vdc
Base-Emitter On Voltage (I _C = 50 mAdc, V _{CE} = 5.0 Vdc)		racerdiana	V _{BE} (on)	100100	1.75	Vdc
SMALL-SIGNAL CHARACTERISTICS				ipbām û.	Pagi shAn	ur = 58
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MH	z)	MMBT5650	C _{obo}	toBAm 0.	7.0	pF B = BD
Input Capacitance (VBE = 0.5, IC = 0, f = 1.0 MHz)	DealSSV	Todatawiw	C _{ibo}	otraga	15 normass	pF pF
Current Gain — High Frequency (IC = 10 mAdc, VCE = 5.0 Vdc, f =	100 MHz)	Both Types	h _{fe}	1.3	K = dl ot Ar	Vdc
Noise Figure (IC = 1.0 mAdc, V _{CE} = 5.0 Vdc, R _S f = 1.0 kHz to 15.7 kHz)	$_{\rm f}$ = 100 k Ω ,	react entM	NF Puty Cycle = 2 0%	- 300 µs, i	10 Sulse, Width	dB

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

		Va		
Rating	Symbol	MMBT6428	MMBT6429	Unit
Collector-Emitter Voltage	VCEO	50	45	Vdc
Collector-Base Voltage	VCBO	60	55	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current — Continuous	Ic	200		mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD.	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	°C

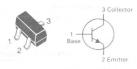
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT6428 = 1K; MMBT6429 = 1L

MMBT6428 MMBT6429

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPSA18 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	adenye.		a) territore no			
Collector-Emitter Breakdown Voltage ($I_C = 1.0 \text{ mAdc}, I_B = 0$) ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	maustar"	MMBT6428 MMBT6429	V(BR)CEO	50 45		Vdc
Collector-Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}, I_E = 0$) ($I_C = 0.1 \text{ mAdc}, I_E = 0$)	wenned)	MMBT6428 MMBT6429	V(BR)CBO	60 55	- 11/1 = V	Vdc
Collector Cutoff Current (VCE = 30 Vdc)	TED SAME		ICEO	_	0.1	μAdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0)			ICBO		0.01	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)	1162		IEBO	_	0.01	μAdo
ON CHARACTERISTICS						
DC Current Gain ($I_C = 0.01 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$)		MMBT6428 MMBT6429 MMBT6428 MMBT6429 MMBT6428 MMBT6429	hFE	250 500 250 500 250 500	650 1250	
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		MMBT6428 MMBT6429		250 500		
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 0.5 \text{ mAdc}$) ($I_C = 100 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)			VCE(sat)	_	0.2 0.6	Vdc
Base-Emitter On Voltage ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$)			V _{BE(on)}	0.56	0.66	Vdc
SMALL-SIGNAL CHARACTERISTICS				Source .	OPPA II	AS 151
Current-Gain — Bandwidth Product $(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f =$	100 MHz)		fT	100	700	MHz
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$	427		C _{obo}	_	3.0	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MHz	111111111111111111111111111111111111111		C _{ibo}		8.0	pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

WATER TO THE TOTAL THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL TO THE TOTAL THE TOTA				
Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	VCEO	350	Vdc	
Collector-Base Voltage	VCBO	350	Vdc	
Emitter-Base Voltage	VEBO	5.0	Vdc	
Base Current	IB	250	mA	
Collector Current — Continuous	Ic	500	mA	

THERMAL CHARACTERISTICS

Symbol	Max	Unit
,* PD	225	mW
2, 1 1 W	1.8	mW/°C
bient R ₀ JA	556	°C/mW
PD	300	Wm 2.4
1 1/6	2.4	mW/°C
bient R _θ JA	417	°C/mW
TJ, Tstg	150	°C
137 1819		100

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT6517 = 1Z

MMBT6517

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





HIGH VOLTAGE TRANSISTOR

NPN SILICON

Refer to 2N6517 for graphs.

Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Оэрияву			ewn Voltage	elisteme umo	oilector-b
Collector-Emitter Breakdown Voltage (I _C = 1.0 mA)		MMARTGAZE MANETBAZE	V(BR)CEO	350	mAde, Ig = 1	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μA)	Увансво	NAMET 6428	V _(BR) CBO	350	ee Br <u>eak</u> derst nAda, ig eed	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA)			V(BR)EBO	6.0	Inevitud Hos	Vdc
Collector Cutoff Current (V _{CB} = 250 V)			СВО	-	50	nA
Emitter Cutoff Current (V _{EB} = 5.0 V)			IEBO	_	50	nA
ON CHARACTERISTICS					Control of the Contro	0.00
DC Current Gain (I _C = 1.0 mA, V _{CE} = 10 V) (I _C = 10 mA, V _{CE} = 10 V) (I _C = 30 mA, V _{CE} = 10 V) (I _C = 50 mA, V _{CE} = 10 V) (I _C = 100 mA, V _{CE} = 10 V)			hFE	20 30 30 20 15	200 200	(1c = 0.01
Collector-Emitter Saturation Voltage (IC = 10 mA, IB = 1.0 mA) (IC = 20 mA, IB = 2.0 mA) (IC = 30 mA, IB = 3.0 mA) (IC = 50 mA, IB = 5.0 mA)		BSAGTEMMA BSAGTEMMA BSAGTAMMA	VCE(sat)	5.0 Vac)	0.30 0.35 0.50 1.0	Vdc r = 50
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA) (I _C = 20 mA, I _B = 2.0 mA) (I _C = 30 mA, I _B = 3.0 mA)	VCE(sot)	MMET6429	VBE(sat)	epartoV no (anAm 8 (a marte)		Vdc
Base-Emitter On Voltage (I _C = 100 mA, V _{CE} = 10 V)	(no)38V		V _{BE(on)}	5.0 Vdd)	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				TERISTICS	NAL CHARAC	MALL-SIG
Current-Gain — Bandwidth Product (I _C = 10 mA, V _{CE} = 20 V, f = 20 N	1Hz)		fT (xHM 00)	40		MHz
Collector-Base Capacitance (V _{CB} = 20 V, f = 1.0 MHz)	odeQ		C _{cb}	HM 0.1 - 1	6.0	pF
Emitter-Base Capacitance (VFB = 0.5 V, f = 1.0 MHz)	Cita		C _{eb}	GREAT 1 - 1	80	o o pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Emitter-Base Voltage	VEBO	5.0	Vdc
Base Current	IB	250	mA
Collector Current — Continuous	Ic.	500	mAdc

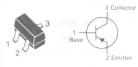
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 114(U)	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stg}	150 W	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBT6520 = 2Z

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



HIGH VOLTAGE TRANSISTOR

PNP SILICON

Refer to 2N6520 for graphs.

Ch	aracteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		Al Instance in the con-			
Collector-Emitter Breakdown Voltage (I _C = 1.0 mA)		V _(BR) CEO	350	8 m 150° . 1	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu A$)	DELIGITY BEARTHAM RESERVE	V(BR)CBO	350	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA)		V(BR)EBO	5.0	_	Vdc
Collector Cutoff Current (V _{CB} = 250 V)	- 989/Rd Y	ICBO	_	50	nA
Emitter Cutoff Current (V _{EB} = 4.0 V)	1022	IEBO	_	50	nA
ON CHARACTERISTICS					
DC Current Gain (IC = 1.0 mA, VCE = 10 V) (IC = 10 mA, VCE = 10 V) (IC = 30 mA, VCE = 10 V) (IC = 50 mA, VCE = 10 V) (IC = 100 mA, VCE = 10 V)		hFE	20 30 30 20 15	200 200	- 20 T 1
Collector-Emitter Saturation Voltage $(I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA})$ $(I_C = 20 \text{ mA}, I_B = 2.0 \text{ mA})$ $(I_C = 30 \text{ mA}, I_B = 3.0 \text{ mA})$ $(I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA})$	HealasV	VCE(sat)	**************************************	0.30 0.35 0.50 1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA) (I _C = 20 mA, I _B = 2.0 mA) (I _C = 30 mA, I _B = 3.0 mA)		VBE(sat)	1_6-	0.75 0.85 0.90	Vdc
Base-Emitter On Voltage (IC = 100 mA, VCE = 10 V)		V _{BE(on)}	SPR TY - I		Vdc
SMALL-SIGNAL CHARACTERISTICS)		9	1146 174 111	
Current-Gain — Bandwidth Product $(I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 20 \text{ M})$	Hz)	f_T	40	200	MHz
Collector-Base Capacitance (V _{CB} = 20 V, f = 1.0 MHz)	No.	C _{cb}	_	6.0	pF
Emitter-Base Capacitance (VFB = 0.5 V, f = 1.0 MHz)		C _{eb}	_	100	pF

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	MMBT8598	MMBT8599	Unit
Collector-Emitter Voltage	VCEO	60	80	٧
Collector-Base Voltage	VCBO	60	80	V
Emitter-Base Voltage	VEBO	5	.0	V
Collector Current — Continuous	Ic	500		mAdc
Total Device Dissipation ((1 TA = 25°C Derate above 25°C		350 2.8		mW mW/°C
Operating and Storage Junction Temperature Range	T _{stg}	- 55 to + 150		°C

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW	
Derate above 25°C		1.8	omW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW	
Derate above 25°C		2.4	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW	
Junction and Storage Temperature	TJ, T _{sta}	150	°C	

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBT8598 = 2K; MMBT8599 = 2W

MMBT8598 MMBT8599

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N4125 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise note	ELECTRICAL	CHARACTERISTICS	(TA =	25°C unless	otherwise noted	1.)
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Char	acteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _E = 0)	овојавју	MMBT8598 MMBT8599	V(BR)CEO	60 80	s dro <u>ak</u> dows	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	069(58)V	MMBT8598 MMBT8599	V(BR)CBO	60 80	Priektown	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	lcso		V(BR)EBO	5.0	off Cerrant	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)	0891		ІСВО	-	50	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)			IEBO		50	nAdc
ON CHARACTERISTICS	340			70	of a well As	n A Lee al
DC Current Gain(1) (I _C = 100 mAdc, V _{CE} = 5.0 Vdc) (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)			hFE	50	150	
Collector-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)			VCE(sat)		0.4	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 5.0 mAdc)			V _{BE(sat)}	_ (A)	0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS				IA	A la = 5.0 m	n Oc = mi
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 10	00 MHz)		fT		Satur ollion V A. lg. = 1.0 g	
Input Capacitance 8.0 (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)			C _{ibo}		08 108 A	
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)			C _{cb}	(V1	4.5	pF
Small-Signal Current Gain $(I_C = 2.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1)$.0 kHz)		h _{fe}		200	MA(L-SIGN
Current Gain — High Frequency (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 1)	00 MHz)		hfe	2.0	A V _C u = 20	m 01 <u>—</u> jo asii maal
Noise Figure (IC = 100 µAdc, VCE = 5.0 Vdc, RS = Noise Bandwidth = 10 Hz to 15.7 kHz			NF		5.0	dB

(1) Pulse Test: Pulse Width $= 300 \mu s$, Duty Cycle = 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	MMBTA05	MMBTA06	Unit
Collector-Emitter Voltage	VCEO	60	80	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	4	.0	Vdc
Collector Current — Continuous	Ic	500		mAdc

THERMAL CHARACTERISTICS

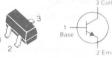
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tsta	150	°C

DEVICE MARKING

MMBTA05 = 1H; MMBTA06 = 1G

MMBTA05 MMBTA06

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





NPN SILICON

Char	acteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	in thinks		The County			
Collector-Emitter Breakdown Voltage(1) $(I_C = 1.0 \text{ mAdc}, I_B = 0)$	27 (18.7	MMBTA05 MMBTA06	V(BR)CEO	60 80		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μ Adc, I _C = 0)	0871		V(BR)EBO	4.0	11 <u>11</u> 11 1	Vdc
Collector Cutoff Current (VCE = 60 Vdc, I _B = 0)	mei		ICEO	_	0.1	μAdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 80 Vdc, I _E = 0)	311	MMBTA05 MMBTA06	ІСВО	_	0.1 0.1	μAdc
ON CHARACTERISTICS		8 FAT 25WIN				
DC Current Gain ($I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)		ETATEMIN NETHVIV	hFE	50 50	- 75.0	-
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)			VCE(sat)	-	0.25	Vdc
Base-Emitter On Voltage (IC = 100 mAdc, VCE = 1.0 Vdc)	30		V _{BE(on)}	e r vo s	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS				-611	ESSECT STREET	112
Current-Gain — Bandwidth Product(2) (I _C = 10 mA, V _{CE} = 2.0 V, f = 100 M	Hz)		f _{Trea 400}	100	174	MHz

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

⁽²⁾ fT is defined as the frequency at which |hfe| extrapolates to unity.

Limiter-pase voltage	VEBO	10	vuc
Collector Current — Continuous	lc lc	300	mAdc

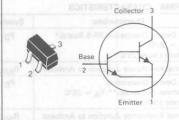
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBTA13 = 1M; MMBTA14 = 1N

SOT-23 (TO-236AA/AB)



DARLINGTON AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N6426 for graphs.

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					DOM: NOTE:	CONTRACTOR DE
Collector-Emitter Breakdown Voltage ($I_C = 100 \mu Adc, I_B = 0$)	USIJ(BBI Y	MMISTAGE	V _{(BR)CES}	30	(0 = B = 0)	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	ОВЗІЯВІУ		ІСВО	egatic	100	nAdc
Emitter Cutoff Current (VBE = 10 Vdc, I _C = 0)			IEBO	-	100	nAdc
ON CHARACTERISTICS(1)	ngni				fi Current	ote: Feballe
DC Current Gain (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)		MMBTA13 MMBTA14	hFE	5000 10,000	yde, y = 0) yde, y = 0)	(VCB = 80 V
$(I_C = 100 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		MMBTA13 MMBTA14		10,000	The Park	D memb3 (D memb3 (m til = 3i)
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 0.1 mAdc)	VCE(sat)		V _{CE} (sat)	v Voltage	1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)	(nellaV		V _{BE}	(Spring)	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				LOUVE U.T	The land	110/0 110
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f =	100 MHz)		fT	125	HoiwbrieS -	MHz

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

⁽²⁾ $f_T = |h_{fe}| \cdot f_{test}$.

and the following of the fit	*EDU	7.0	V UC
Collector Current — Continuous	Ic	100	mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* T _A = 25°C Derate above 25°C	PD	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBTA20 = 1C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE AMPLIFIER

NPN SILICON

Refer to MPS3904 for graphs.

Characteri	stic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	my3		(* 17 Ko. 155 Aurus) (*			
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	aray T		V(BR)CEO	40		Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)		EM M	V(BR)EBO	4.0		Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)			ICBO	_	100	nAdc
ON CHARACTERISTICS	The second second			1 1 1 1 1 1 1 1		
DC Current Gain (I _C = 5.0 mAdc, V _{CE} = 10 Vdc)			hFE	40	400	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)			VCE(sat)	_	0.25	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 100 MH		SHAN	fT	125		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	ųd.		C _{obo}		4.0	pF
		1 1207		10071		

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	MMBTA42	MMBTA43	Unit
Collector-Emitter Voltage	VCEO	300	200	Vdc
Collector-Base Voltage	VCBO	300	200	Vdc
Emitter-Base Voltage	VEBO	6.0 6.0		Vdc
Collector Current — Continuous	Ic	500		mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* Τ _Δ = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBTA42 = 1D; MMBTA43 = 1E

MMBTA42 MMBTA43

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





HIGH VOLTAGE TRANSISTOR

NPN SILICON

Refer to MPSA42 for graphs.

Cha	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS				apptioV nv	workstantiff noti	Im3-ratael
Collector-Emitter Breakdown Voltage(1 (I _C = 1.0 mAdc, I _B = 0)	083(88) ⁹	MMBTA42 MMBTA43	V(BR)CEO	300 200	Ade, lg = 01 Presidents Ade, ET = 01	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	Q80)	MMBTA42 MMBTA43	V(BR)CBO	300 200	off Current Vdo, (F = 0)	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)	gart		V(BR)EBO	6.0	nii	Vdc
Collector Cutoff Current (V _{CB} = 200 Vdc, I _E = 0) (V _{CB} = 160 Vdc, I _E = 0)	VGE(sav)	MMBTA42 MMBTA43	ІСВО	e <u>pai</u> loV i <u>to</u> hAm	0.1 0.1	μAdc
Emitter Cutoff Current (VBE = 6.0 Vdc, I _C = 0) (VBE = 4.0 Vdc, I _C = 0)	71	MMBTA42 MMBTA43	IEBO	Points Forms 1 No. 1 =	0.1 0.1	μAdc
ON CHARACTERISTICS(1)					Banks	Degs Fred
DC Current Gain $ \begin{aligned} &(I_C = 1.0 \text{ mAdc, V}_{CE} = 10 \text{ Vdc}) \\ &(I_C = 10 \text{ mAdc, V}_{CE} = 10 \text{ Vdc}) \end{aligned} $ $ (I_C = 30 \text{ mAdc, V}_{CE} = 10 \text{ Vdc}) $		Both Types Both Types MMBTA42 MMBTA43	hFE	25 40 40 40	0 = g .0±	01 _90
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		MMBTA42 MMBTA43	VCE(sat)	=	0.5 0.5	Vdc
Base-Emitter Saturation Voltage $(I_C = 20 \text{ mAdc}, I_B = 2.0 \text{ mAdc})$			V _{BE(sat)}	-	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f =	100 MHz)		fT	50		MHz
Collector-Base Capacitance $(V_{CB} = 20 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$	()	MMBTA42 MMBTA43	C _{cb}	=	3.0 4.0	pF

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	MMBTA55	MMBTA56	Unit
Collector-Emitter Voltage	VCEO	60	80	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	4.0		Vdc
Collector Current — Continuous	Ic	500		mAdd

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{sta}	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBTA55 = 2H; MMBTA56 = 2G

MMBTA55 MMBTA56

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





DRIVER TRANSISTOR

PNP SILICON

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	loamo-3		JUNETER			
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	Valuativ	MMBTA55 MMBTA56	V(BR)CEO	60 80	=	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)			V(BR)EBO	4.0	-	Vdc
Collector Cutoff Current (VCE = 60 Vdc, IB = 0)	Jose		ICEO	_	0.1	μAdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 80 Vdc, I _E = 0)		MMBTA55 MMBTA56	ICBO	_	0.1 0.1	μAdc
ON CHARACTERISTICS		DEALEWIL				
DC Current Gain ($I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	m 35 /	- A Length	hFE	50 50		_
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc)	(SpiSh) ^M		VCE(sat)	-	0.25	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)			V _{BE(on)}	EMPRIS I	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS			•			
Current-Gain — Bandwidth Product(2) (I _C = 100 mAdc, V _{CE} = 1.0 Vdc, f =	100 MHz)		fT	50	_	MHz

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

⁽²⁾ fT is defined as the frequency at which |hfe| extrapolates to unity.

WAXIII OW HATTINGO			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCES	30	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	10	Vdc
Collector Current — Continuous	lc lc	500	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

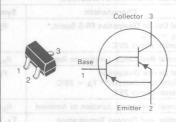
^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBTA63 = 2V; MMBTA64 = 2U

MMBTA63 MMBTA64

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



DARLINGTON TRANSISTOR

PNP SILICON

Refer to MPSA75 for graphs.

	Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		Parameter		1	rispettoV nw	or Emilian Dieakdown V	
Collector-Emitter Breakdown (I _C = 100 μAdc)	Voltage			V _(BR) CES	30	$0 = e^{\frac{1}{2}} \cos \rho c$	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc)	0.8	ова(яв) У		ІСВО	aganoV	nwc100 an8 0 = 51 at Au	
Emitter Cutoff Current (VBE = 10 Vdc)		OBO		IEBO	-	100 to	
ON CHARACTERISTICS						Institut the	tuD lomelig
DC Current Gain(1) (IC = 10 mAdc, V _{CE} = 5.0 (IC = 10 mAdc, V _{CE} = 5.0 (IC = 100 mAdc, V _{CE} = 5.0	0 Vdc)		MMBTA63 MMBTA64 MMBTA63	hFE	5,000 10,000 10,000	Vdo, ig = 0 Vdo, ig = 0	06 - 85V) 04 CH . FFA.
(I _C = 100 mAdc, V _{CE} = 5			MMBTA64		20,000		Courant C
Collector-Emitter Saturation ($I_C = 100 \text{ mAdc}$, $I_B = 0.1$		(martin)		VCE(sat)	1.0 Veltage	1.50An	
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 5	i.0 Vdc)	(exchag)		VBE(on)	(ohAm 0)	2.0 An	
SMALL-SIGNAL CHARACTE	RISTICS					= ggW jabArr	$(00)^2 = (00)$
Current-Gain — Bandwidth (I _C = 10 mAdc, V _{CE} = 5.		100 MHz)		fT		JARRAES JAN Bendwist	MHz

⁽¹⁾ Pulse Test: Pulse Width \leq 300 $\mu\text{s},$ Duty Cycle \leq 2.0%.

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	lc l	100	mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 Win 1.8	mW/°C
	-		
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBTA70 = 2C

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N5086 for graphs.

Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS				-	auta a t	1.0
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	033000	seatáblia	V(BR)CEO	40	e o Tang	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)		PEATEMM	V(BR)EBO	4.0	u liskog miljis	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	333211110000		ICBO	_	100	nAdc
ON CHARACTERISTICS	DBB(FB)V			e, in it 7	r agenta	
DC Current Gain (I _C = 5.0 mAdc, V _{CE} = 10 Vdc)	GRO		hFE	40	400	-
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		MARS ASS WORSTAIN	V _{CE} (sat)	_	0.25	Vdc
SMALL-SIGNAL CHARACTERISTICS	17.4				431	
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f =	100 MHz)		f _T	125	pai p a i	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	cecpy II dini)	C _{obo}	1 4000	4.0	pF

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	MMBTA92	MMBTA93	Unit
Collector-Emitter Voltage	VCEO	300	200	Vdc
Collector-Base Voltage	VCBO	300	200	Vdc
Emitter-Base Voltage	VEBO	5.0	5.0	Vdc
Collector Current — Continuous	IC IC	5	00	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,*	PD	225	mW
T _A = 25°C Derate above 25°C		Vm 2 1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBTA92 = 2D; MMBTA93 = 2E

MMBTA92 MMBTA93

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





HIGH VOLTAGE TRANSISTOR

PNP SILICON

Refer to MPSA92 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

William Owier	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					EUROBISTUA	mand m
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	OBSIBELY	MMBTA92 MMBTA93	V(BR)CEO	300 200	nicer Eleaide Tr'Ade, Ig = 0 S Bre <u>alu</u> down	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	0801	MMBTA92 MMBTA93	V(BR)CBO	300 200	soff Current O Vdc_Lg = 0	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)			V(BR)EBO	5.0	Cristance Cein	Vdc
Collector Cutoff Current (VCB = 200 Vdc, I _E = 0) (VCB = 160 Vdc, I _E = 0)	Verteau	MMBTA92 MMBTA93	СВО	10 Vdc) on Voltage 0 mAde)	0.25	μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)			IEBO	aon a lasti	0.1	μAdc
ON CHARACTERISTICS(1)			RHM oor	- Laby 01	= apV abAm	0.8 = 0.0
DC Current Gain (I _C = 1.0 mAdc, V_{CE} = 10 Vdc) (I _C = 10 mAdc, V_{CE} = 10 Vdc) (I _C = 30 mAdc, V_{CE} = 10 Vdc)	odo ⁰	Both Types Both Types MMBTA92	hFE	25 40 25		opel laga (Ves = 1
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		MMBTA92 MMBTA93	VCE(sat)	25 — —	0.5 0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)			V _{BE(sat)}	-	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f	= 100 MHz)		fT	50	_	MHz
Collector-Base Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 M	Hz)	MMBTA92 MMBTA93	C _{cb}	=	6.0 8.0	pF

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc

THERMAL CHARACTERISTICS

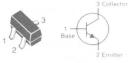
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stq}	150	°C

DEVICE MARKING

MMBTH10 = 3E

MMBTH10

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)



VHF/UHF TRANSISTOR

NPN SILICON

Refer to MPSH10 for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO	25	16. 1-	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	V(BR)CBO	30	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	3.0	interior in the second	Vdc
Collector Cutoff Current $(V_{CB} = 25 \text{ Vdc}, I_E = 0)$	ICBO	_	100	nAdc
Emitter Cutoff Current (V _{BE} = 2.0 Vdc, I _C = 0)	IEBO	_	100	nAdc
ON CHARACTERISTICS		THE STATE OF		
DC Current Gain (I _C = 4.0 mAdc, V _{CE} = 10 Vdc)	hFE	60	1 n n n n n n	-
Collector-Emitter Saturation Voltage (I _C = 4.0 mAdc, I _B = 0.4 mAdc)	VCE(sat)	_	0.5	Vdc
Base-Emitter On Voltage (I _C = 4.0 mAdc, V _{CE} = 10 Vdc)	V _{BE}		0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS			20.31.51	
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	An inc. The Proof of Table	650	_	MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	C _{cb}	-	0.7	pF
Common-Base Feedback Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$)	C _{rb}	_	0.65	pF
Collector Base Time Constant (I _C = 4.0 mAdc, V _{CB} = 10 Vdc, f = 31.8 MHz)	rb′C _c	_	9.0	ps

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	Ic	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C	- 1 - 9	1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBTH24 = 3A

MMRTH24

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)





VHF MIXER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

the Chara	cteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				25	IN BIRE TO A	8/39 380
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V (BRICEO	V(BR)CEO	30	(0 = 0)	mit a <u>r Bres</u> mAds, Ig	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	ово(яв)У	V(BR)CBO	40		sso Egraled LuArle, fg	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	Ованяя	V(BR)EBO	4.0		e Br <u>oste</u> dos uAde, lig =	Vdc
Collector Cutoff Current (VCB = 15 Vdc, I _E = 0)	deal	ІСВО		- 17 (B)	50	nAdc
ON CHARACTERISTICS	088				off Current	lu. heldim
DC Current Gain (IC = 8.0 mAdc, VCE = 10 Vdc)		hFE	30	8	DETERMENT OF	NO CHARA
SMALL-SIGNAL CHARACTERISTICS	크리아				Gaie	Current
Current-Gain — Bandwidth Product(1) (I _C = 8.0 mAdc, V _{CE} = 10 Vdc, f =	100 MHz)	fT	400	620	atter Sets	MHz
Collector-Base Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz	s) 38V	C _{cb}		0.25	0.36	pF
Conversion Gain (213 MHz to 45 MHz)			80	SACTERIST	NAL CHA	dB
$(I_C = 8.0 \text{ mAdc}, V_{CC} = 20 \text{ Vdc}, C)$ (60 MHz to 45 MHz)		CG		24		
$(I_C = 8.0 \text{ mAdc}, V_{CC} = 20 \text{ Vdc}, C)$	scillator Injection = 150 mVrms)		24	29	industrial and	L orgalia

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Conector-Limiter voltage	VCEO.	had 20	Vdc
Collector-Base Voltage	VCBO	shy 20	Vdc
Emitter-Base Voltage	VERO	3.0	Vdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	Am 225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T _J , T _{stq}	150	≥ °C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

DEVICE MARKING

MMBTH81 = 3D

CASE 318-02/03, STYLE 6 SOT-23 (TO-236AA/AB)

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UHF/VHF TRANSISTOR

PNP SILICON

Characteristic Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			F 3	1 11 11	
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO	20	<u>(6.11)</u> 1*	_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	V(BR)CBO	20		_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	3.0	_	-	Vdc
Collector Cutoff Current $(V_{CB} = 10 \text{ Vdc}, I_E = 0)$	ICBO	1031-45	<u></u>	100	nAdc
Emitter Cutoff Current (V _{BE} = 2.0 Vdc, I _C = 0)	IEBO	_	_	100	nAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 5.0 mAdc, V _{CE} = 10 Vdc)	hFE	60	_	_	_
Collector-Emitter Saturation Voltage ($I_C = 5.0 \text{ mAdc}$, $I_B = 0.5 \text{ mAdc}$)	VCE(sat)	_	_	0.5	Vdc
Base-Emitter On Voltage ($I_C = 5.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$)	VBE(on)	_	_	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	f _T	600	_	_	MHz
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	C _{cb}	_	_	0.85	pF
Collector-Emitter Capacitance (I _B = 0, V _{CB} = 10 Vdc, f = 1.0 MHz)	C _{ce}	_	_	0.65	pF

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	30	Vdc
Forward Current	BAO IF	200	mAdo

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Total Device Dissipation FR-5 Board,* T _A = 25°C - Derate above 25°C	PD	225	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW	
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW/°C	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Vm 2 417	°C/mW	
Junction and Storage Temperature	TJ, T _{sta}	150	°C	

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBV105G = 4E

MMBV105G

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)





VOLTAGE VARIABLE CAPACITANCE DIODE

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) with present the control of the c

Characteristic Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS				35	ACTERRITA	OFF CHA
Reverse Breakdown Voltage ($I_R = 10 \mu Adc$)	(BB)V	V(BR)	30		meul ar Brae MAdic, Ig	Vdc
Reverse Voltage Leakage Current (VR = 28 Vdc)		IR		own V allaga 0i	50	
Series Inductance (f = 250 MHz)	(RO)V	LS	-	3.0	se H ankdor pAda, I <u>c</u> =	
Diode Capacitance Temperature Coefficient (V _R = 3.0 Vdc, f = 1.0 MHz)	apt l	TCC	-	280	arot t C yrrei 10 Vda, Ig	P P
Diode Capacitance (V _R = 25 Vdc)	85	CT	1.8	(0 +	2.8	100
Capacitance Ratio (V _{R1} = 3.0 Vdc, V _{R2} = 25 Vdc, f = 1.0 MHz)		C3/C25	4.0	- 8	6.0	ON CHAIR

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	VR	30	Vdc
Forward Current	I _F	200	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD		mW mW
Derate above 25°C	100	2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBV109 = 4A

MMBV109

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)





VOLTAGE VARIABLE CAPACITANCE DIODE

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit			
OFF CHARACTERISTICS								
Reverse Breakdown Voltage (I _R = 10 µAdc)	V(BR)	30	18 <u>18</u>		Vdc			
Reverse Voltage Leakage Current (V _R = 28 Vdc)	IR			0.1	μAdc			
Series Inductance (f = 250 MHz)	LS	_	3.0	_	nH			
Case Capacitance (f = 1.0 MHz)		_	0.1	_	pF			
Diode Capacitance Temperature Coefficient (V _R = 3.0 Vdc, f = 1.0 MHz)	TCC	-	280	_	ppm/°C			
Figure of Merit (V _R = 3.0 Vdc, f = 50 MHz)	Q	200	_	-	_			
Diode Capacitance (V _R = 3.0 Vdc, f = 1.0 MHz)	CT and CT	26	-	32	pF			

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

e01V8MM

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)

MMBV409 MMBV409L

CASE 182-02, STYLE 1 (TO-226AC)



MAXIMUM BATINGS

		MV409	MMBV409,L	
Rating	Symbol	OWN	Unit	
Reverse Voltage	VR	Wmo	20	Volts
Forward Current	1 _F	200		mA
Forward Power Dissipation (a T _A = 25°C Derate above 25°C	PD	280 2.8	225* 1.8	mW mW/°C
Junction Temperature	TJ	+ 125		°C
Storage Temperature Range	T _{stg}	-65 to +150		°C

CASE 318-02, STYLE 8 SOT-23 (TO-236AA)



VOLTAGE VARIABLE CAPACITANCE DIODE

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic — All Types	Symbol	nbol Min	Тур	Max	Unit
Reverse Breakdown Voltage (IR = 10 μAdc)	V _{(BR)R}	20	BRO	ACTERISTIC	Vdc
Reverse Voltage Leakage Current (V _R = 15 Vdc)	IR	-	— ege	eakut.on Vol µAde)	μAdc
Diode Capacitance Temperature Coefficient (V _R = 3 Vdc, f = 1 MHz)	TCC	-	300	(toge -Lookeg Fyde)	ppm/°C

			C _t , Diode Capacitance V _R = 3 Vdc, f = 1 MHz		Q, Figure of Merit VR = 3 Vdc f = 50 MHz (Note 1)	C _R , Capacit C ₃ // f = 1 (Not	C ₈ MHz		
2000		vice		Min	Nom	Max	Min	Min	Max
MMBV409,	L/MV409		200	26	29	32	200	na 1.5 -bv	1.9

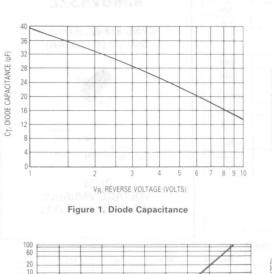
NOTES ON TESTING AND SPECIFICATIONS

(1) O is calculated by taking the G and C readings of an admittance bridge, such as Boonton Electronics Model 33AS8, at the specified frequency and substituting in the following equation:

 $Q = \frac{2\pi fC}{G}$

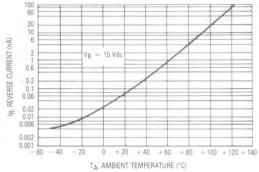
(2) CR is the ratio of Ct measured at 3 Vdc divided by Ct measured at 8 Vdc.

^{*}FR5 Board 1.0 x 0.75 x 0.62 in.



2 1.5 0.7 0.5 0.5 0.2 0.2 0.2 0.4 5.6 7.8 9.10 11 12 13 14 V_R, REVERSE VOLTAGE VOLTS

Figure 2. Figure of Merit



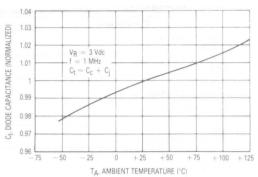


Figure 3. Leakage Current

Figure 4. Diode Capacitance

MAXIMUM RATINGS (Each Diode)

Rating	Symbol	Value	Unit
Reverse Voltage	VR	14	Volts
Forward Current	I _F	200	mA

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C.

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBV432L = 4B

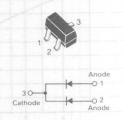
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
Reverse Breakdown Voltage (I _R = 10 μAdc)	V(BR)R	14			Vdc
Reverse Voltage Leakage Current (V _R = 9.0 Vdc)	IR		389 44	100	nAdc
Diode Capacitance (V _R = 2.0 Vdc, f = 1.0 MHz)	CT	43	S.	48.1	pF
Capacitance Ratio C2/C8 (f = 1.0 MHz)	CR	1.5		2.0	\$0.0
Figure of Merit* (V _R = 2.0 Vdc, f = 100 MHz)	Q	75	100		0.002

^{*} Q = $\frac{1}{2 \pi f C_T R_S}$

MMBV432L

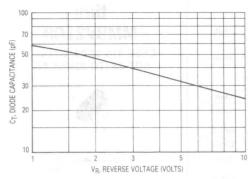
CASE 318-02, STYLE 9 SOT-23 (TO-236AA)



DUAL VOLTAGE-VARIABLE CAPACITANCE DIODE

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

TYPICAL CHARACTERISTICS (Each Diode)



450

Hay Way 150

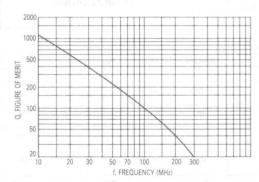
TA = 25°C

T = 100 MHz

VB, REVERSE VOLTAGE (VOLTS)

Figure 1. Diode Capacitance (Each Diode)

Figure 2. Figure of Merit versus Voltage



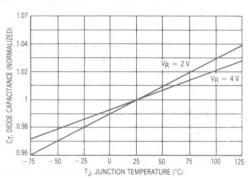


Figure 3. Figure of Merit versus Frequency

Figure 4. Diode Capacitance versus Temperature

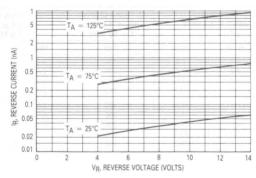


Figure 5. Reverse Current versus Reverse Voltage

Rating	Symbol	Value	Unit
Reverse Voltage	VR	30	Vdc
Forward Current	l _F	20	mAdc

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{stg}	150	°C

MMBV2109

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



30-Anode Cathode

TUNING DIODE

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					- 3
Reverse Breakdown Voltage (IR = 10 μ Adc)	V(BR)	30	MT.		Vdc
Reverse Voltage Leakage Current (V _R = 25 Vdc)	IR			20	nAdc
Series Inductance $(f = 250 \text{ MHz}, \text{Lead Length} \approx 1/16")$	Ls		3.0		nH
Case Capacitance $(f = 1.0 \text{ MHz}, \text{Lead Length} \approx 1/16")$	CC	TION TO VIOLE	0.15	()	pF
Diode Capacitance Temperature Coefficient (V _R = 4.0 Vdc, f = 1.0 MHz)	Tcc	Medit verb	280	400	ppm/°C

Device V _R = 4.0 Vdc	C _T , Diode Capacitance V _R = 4.0 Vdc, f = 1.0 MHz pF			Q, Figure of Merit VR = 4.0 Vdc f = 50 MHz	TR, Tuning Ratio C ₂ /C ₃₀ f = 1.0 MHz		Marking
	Nom	Max	Тур	Min	Max	Тор	
MMBV-2101	6.1	6.8	7.5	400	2.5	3.2	4G
MMBV-2102	7.3	8.2	9.0	400	2.5	3.2	4S
MMBV-2103	9.0	10	11	350	2.5	3.2	4H
MMBV2104	10.8	12	13.2	350	2.5	3.2	4T
MMBV-2105	13.5	15	16.5	350	2.5	3.2	4U
MMBV-2106	16.2	18	19.8	300	2.5	3.2	4V
MMBV-2107	19.8	22	24.2	300	2.5	3.2	4W
MMBV-2108	24.3	27	29.7	250	2.5	3.2	4X
MMBV-2109	29.7	33	36.3	150	2.5	3.2	4J

Figure 5. Reverse Climent versus Reverse Voltage

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit	
Reverse Voltage	VR	30	Vdc	
Forward Current	IF	200	mAdc	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstq	150	°C

DEVICE MARKING

MMBV3102 = 4C

MMBV3102

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



Cathode

VOLTAGE VARIABLE CAPACITANCE DIODE

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				31-01	
Reverse Breakdown Voltage (I _R = 10 μAdc)	V _(BR)	30	780	_	Vdc
Reverse Voltage Leakage Current (V _R = 25 Vdc)	IR	_	- 7115	0.1	μAdc
Series Inductance (f = 250 MHz)	LS	_	3.0		nH
Case Capacitance (f = 1.0 MHz)	CC	_	0.1	_	pF
Diode Capacitance Temperature Coefficient (V _R = 3.0 Vdc, f = 1.0 MHz)	T _{CC}	_	280		ppm/°C
Figure of Merit (V _R = 3.0 Vdc, f = 50 MHz)	Q	200	177/18	-	-
Diode Capacitance (V _R = 3.0 Vdc, f = 1.0 MHz)	C _T	20	-	25	pF

^{*}FR-5 = 1.0 x 0.75 x 0.62 in. **Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Rating	Symbol	Value	Unit
Reverse Voltage	V _R	35	Vdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C Derate above 25°C	PD	225	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta}JA$	556	°C/mW
Total Device Dissipation Alumina Substrate,** TA = 25°C Derate above 25°C	PD	300	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, T _{sta}	150	081 °C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

DEVICE MARKING

MMBV3401 = 4D

MMRV3401

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)



3 O O 1 Cathode Anode

SILICON PIN SWITCHING DIODE

	Characterist	ic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	r cellur	ionnile		A 10 10 10 10 10 10	50	rainava	0.47 6 550
Reverse Breakdown Voltage (I _R = 10 μAdc)			V(BR)	35	epstic	V nwobose	Vdc
Reverse Voltage Leakage Cu (V _R = 25 Vdc)	rrent	al	IR	-	ge Current	0.1	μAdc
Series Inductance (f = 250 MHz)	8 1 -	e)	Ls	-	3.0	earisto	nH
Series Resistance (I _F = 10 mAdc)	1 -	D ²	RS	-	-	0.7	Ohms
Case Capacitance (f = 1.0 MHz)	9 - 3	33 ^T	CC	melaithe	0.1	aT sometion	pF
Diode Capacitance (V _R = 20 Vdc, f = 1.0 MH	z) 200	Ø	C _T	-	(4184.0)	1.0	A to Shugi

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Reverse Voltage	VR	200	Volts

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* TA = 25°C	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C	PD	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tstg	150	°C

^{*}FR-5 = $1.0 \times 0.75 \times 0.62$ in.

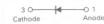
DEVICE MARKING

MMBV3700 = 4R

MMBV3700

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)





SILICON PIN SWITCHING DIODE

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

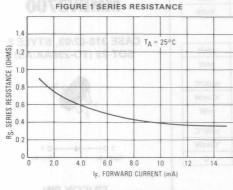
Characteristic	Symbol	Min	Тур	Max	Unit
Reverse Breakdown Voltage (IR = 10 μ A)	V(BR)R	200	_	-	Volts
Diode Capacitance (Note 1) (V _R = 20 Vdc, f = 1.0 MHz)	CT			1.0	pF
Series Resistance (Figure 5) (I _F = 10 mA)	RS	-	0.4	1.0	Ohms
Reverse Leakage Current (V _R = 150 Vdc)	IR		_	0.1	μΑ
Reverse Recovery Time (IF = IR = 10 mA)	trr	STATIVITATION	300	_	ns

NOTE:

^{**}Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

^{1.} C_T is measured using a capacitance bridge (Boonton Electronics Model 75A or equivalent).

TYPICAL ELECTRICAL CHARACTERISTICS



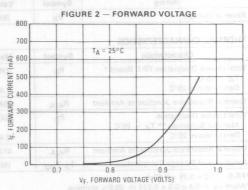


FIGURE 3 — DIODE CAPACITANCE

8.0
6.0
4.0
4.0
7
7
A = 25°C

0.0
0 — 10 — 20 — 30 — 40 — 50
V_R. REVERSE VOLTAGE (VOLTS)

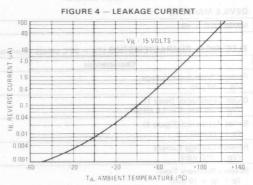
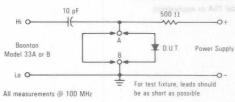


FIGURE 5 - FORWARD SERIES RESISTANCE TEST METHOD



To measure series resistance, a 10 pF capacitor is used to reduce the forward capacitance of the circuit and to prevent shorting of the external power supply through the bridge. The small signal from the bridge is prevented from shorting through the power supply by the 500-ohm resistor. The resistance of the 10 pF capacitor can be considered negligible for this measurement.

The RF Admittance Bridge (Boonton 33A or B) must be initially balanced, with the test circuit connected to the bridge test terminals. The conductance scale will be set at zero and the capacitance scale will be set at 120 pF, as required when using the 100 MHz test coil.

- Use a short length of wire to short the test circuit from point "A" to "B". Then connect the power supply providing 10 mA of bias current to the test circuit.
- Adjust the capacitance scale arm of the bridge and the "G" zero control for a minimum null on the "null meter". The null occurs at approximately 130 pF.
- Replace the wire short with the device to be tested. Bias the device to a forward conductance state of 10 mA.
- Obtain a minimum null on the "null meter", with the capacitance and conductance scale adjustment arms.
- 6. Read conductance (G) direct from the scale. Now read the capacitance value from the scale ($\approx 130~\text{pF}$) and subtract 120 pF which yields capacitance (C). The forward resistance (Rs) can now be calculated from:

$$R_S = \frac{2.533 \text{ G}}{C^2}$$

Where

G — in micromhos,

C — in pF,

Rs - in ohms

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_{A} = 25^{\circ}C$	PD	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** T _A = 25°C Derate above 25°C	PD	300	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	TJ, Tsta	150	°C

^{*}FR-5 = 1.0 x 0.75 x 0.62 in.

MMBZ5226B thru MMBZ5257B

CASE 318-02/03, STYLE 8 SOT-23 (TO-236AA/AB)





ZENER DIODES

Pinout: 1-Anode, 2-NC, 3-Cathode (V_F = 0.9 V Max @ I_F = 10 mA for all types.)

Device	Marking	Test Current IZT mA	Zener Voltage Vz (±5%) Nominal	Z_{ZK} $I_{Z} = 0.25 \text{ mA}$ $\Omega \text{ Max}$	Z _{ZT} I _Z = I _{ZT} (a: 10% Mod Ω Max	Max I _R μA	v _R
MMBZ5226B	8A	20	3.3	1600	28	25	1.0
MMBZ5227B	8B	20	3.6	1700	24	15	1.0
MMBZ5228B	8C	20	3.9	1900	23	10	1.0
MMBZ5229B	8D	20	4.3	2000	22	5.0	1.0
MMBZ5230B	8E	20	4.7	1900	19	5.0	2.0
MMBZ5231B	8F	20	5.1	1600	17	5.0	2.0
MMBZ5232B	8G	20	5.6	1600	11	5.0	3.0
MMBZ5233B	8H	20	6.0	1600	7.0	5.0	3.5
MMBZ5234B	8J	20	6.2	1000	7.0	5.0	4.0
MMBZ5235B	8K	20	6.8	750	5.0	3.0	5.0
MMBZ5236B	8L	20	7.5	500	6.0	3.0	6.0
MMBZ5237B	8M	20	8.2	500	8.0	3.0	6.5
MMBZ5238B	8N	20	8.7	600	8.0	3.0	6.5
MMBZ5239B	8P	20	9.1	600	10	3.0	7.0
MMBZ5240B	80	20	10	600	3514 17	3.0	8.0
MMBZ5241B	8R	20	11	600	22	2.0	8.4
MMBZ5242B	85	20	12	600	30	1.0	9.1
MMBZ5243B	8T	9.5	13	600	13	0.5	9.9
MMBZ5244B	8U	9.0	14	600	15	0.1	10
MMBZ5245B	8V	8.5	15	600	16	0.1	11
MMBZ5246B	8W	7.8	16	600	17	0.1	12
MMBZ5247B	8X	7.4	17	600	19	0.1	13
MMBZ5248B	8Y	7.0	18	600	21	0.1	14
MMBZ5249B	8Z	6.6	19	600	23	0.1	14
MMBZ5250B	81A	6.2	20	600	25	0.1	15
MMBZ5251B	81B	5.6	22	600	29	0.1	17
MMBZ5252B	81C	5.2	24	600	33	0.1	18
MMBZ5253B	81D	5.0	25	600	35	0.1	19
MMBZ5254B	81E	4.6	27	600	41	0.1	21
MMBZ5255B	81F	4.5	28	600	44	0.1	21
MMBZ5256B	81G	4.2	30	600	49	0.1	23
MMBZ5257B	81H	3.8	33	700	58	0.1	25

^{**}Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.



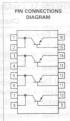
Rating	Symbol	MMPQ2222	MMPQ2222A	Unit
Collector-Emitter Voltage	VCEO	30	40	Vdc
Collector-Base Voltage	VCB	60	75	Vdc
Emitter-Base Voltage	VEB	5.0 6.F		Vdc
Collector Current — Continuous	IC	Amio 500 388		mAdc

		Each Transistor	Four Transistors Equal Power	
Total Power Dissipation (a T _A = 25°C Derate above 25°C	PD	0.52 4.2	1.0 8.0	Watts mW/°C
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	0.8 6.4	2.4 19.2	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

MMPQ2222 MMPQ2222A

CASE 751B-03 SO-16





QUAD GENERAL-PURPOSE TRANSISTOR

NPN SILICON

Characteris	tic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	17 = 0.25 mA 6 18%	V2 (25%)	751			
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	MMPQ2222 MMPQ2222A	V(BR)CEO	30 40	gessean 48		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	MMPQ2222 MMPQ2222A	V(BR)CBO	60 75	- 138 - 138	52728	Vdc
Emitter-Base Breakdown Voltage (I _B = 10 μ Adc, I _C = 0)	81 0087	V(BR)EBO	5.0	38	5230 <u>6_</u>	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0)	MMPQ2222 MMPQ2222A	a CBO	20 	28 +-18 18	50 10	nAdd
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	MMPQ2222 MMPQ2222A	IEBO	05	- 78 - 78	50 10	nAdd
ON CHARACTERISTICS	8.0	2.6	20	148		18MM
DC Current Gain(1) (I _C = 100 µA, V _{CE} = 10 V) (I _C = 1.0 mA, V _{CE} = 10 V) (I _C = 10 mA, V _{CE} = 10 V) (I _C = 150 mA, V _{CE} = 10 V) (I _C = 300 mA, V _{CE} = 10 V) (I _C = 500 mA, V _{CE} = 10 V) (I _C = 150 mA, V _{CE} = 10 V) (I _C = 150 mA, V _{CE} = 10 V)	MMPQ2222A MMPQ2222A MMPQ2222 MMPQ2222 MMPQ2222A MMPQ2222A MMPQ2222A MMPQ2222A MMPQ2222A MMPQ2222A	re hfe	35 50 75 75 100 100 30 40 50	198 198 198 198 198 198 198 198 198 198	300	LEMM LEMM LEMM LEMM SMIM SMIM SMIM SMIM SMIM SMIM SMIM S
Collector-Emitter Saturation Voltage(1) $ \begin{pmatrix} I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc} \end{pmatrix} $ $ \begin{pmatrix} I_C = 300 \text{ mAdc}, I_B = 30 \text{ mAdc} \end{pmatrix} $ $ \begin{pmatrix} I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc} \end{pmatrix} $	MMPQ2222 MMPQ2222A MMPQ2222 MMPQ2222A	VCE(sat)	8.8 8.2 6.2 7.6	218 218 218	0.4 0.3 1.6 1.0	SAMM SEMM SEMM SEMM
Base-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	MMPQ2222 MMPQ2222A MMPQ2222 MMPQ2222A	VBE(sat)	6.0 4.5 4.5 4.5	G18 318 318 318 318 318	1.3 1.2 2.6 2.0	Vdc

MMPQ2222, MMPQ2222A

ELECTRICAL CHARACTERISTICS (Continued)

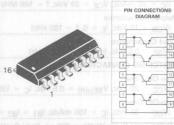
Characteristic	Symbol	Min	Тур	Max	Unit
DYNAMIC CHARACTERISTICS					
Current-Gain — Bandwidth Product(1) (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	_	350	0 1 1 T 1 T 1 T 1	MHz
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$	Cob	6 //m <u>=2</u> 1969/	4.5		pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)	C _{ib}	HQ2-	17		pF
SWITCHING CHARACTERISTICS					
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc}, I_{C} = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc})$	ton		25	_	ns
Turn-Off Time (V _{CC} = 30 Vdc, I _C = 150 mAdc, I _{B1} = I _{B2} = 15 mAdc). The state of the stat	toff	_	250	_	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle = 2.0%.

MAXIMUM RATINGS Rating Symbol Value Unit Vdc Collector-Emitter Voltage VCEO 15 40 Vdc Collector-Base Voltage VCB Emitter-Base Voltage VEB 4.5 Vdc Collector Current — Continuous 500 mAdc IC

28	7000	674		- 100		
an			-	Each Transistor	Four Transistors Equal Power	igl .ab/
	ower Dissipation e above 25°C	$n (ii) T_A = 25^{\circ}C$	PD	0.4 3.2	0.72 6.4	Watts mW/°C
	ower Dissipation e above 25°C	$m (u T_C = 25^{\circ}C)$	PD	0.66 5.3	1.92 15.4	Watts mW/°C
	ng and Storage erature Range		T _J , T _{stg}	-55 to +150		°C





QUAD SWITCHING TRANSISTOR

NPN SILICON

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, I _B = 0)	V(BR)CEO	15		_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	40	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	4.5			Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)	СВО	_	_	0.4	μAdo
Emitter Cutoff Current (V _{BE} = 3.0 Vdc, I _C = 0)	IEBO		-	0.5	μAdo
ON CHARACTERISTICS					
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 100 mAdc, V _{CE} = 2.0 Vdc)	hFE	40 20	=	=	-
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)		-	0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE} (sat)		-	0.9	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	450	550		MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 140 kHz)	C _{ob}	_	2.5	4.0	pF
Input Capacitance (VBE = 0.5 Vdc , IC = 0 , f = 140 kHz)	C _{ib}		3.0	5.0	pF
SWITCHING CHARACTERISTICS					
Turn-On Time $(V_{CC} = 3.0 \text{ Vdc}, V_{BE(off)} = 1.5 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = 3.0 \text{ mAdc})$	t _{on}		9.0		ns
Turn-Off Time $(V_{CC} = 3.0 \text{ Vdc}, I_C = 10 \text{ mAdc}, I_{B1} = 3.0 \text{ mAdc}, I_{B2} = 1.5 \text{ mAdc})$	toff	-	15	-	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle = 2.0%.

Rating	Symbol	MMPQ2907	MMPQ2907A	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Base Voltage	VCB	60		Vdc
Emitter-Base Voltage	VEB	5.0		Vdc
Collector Current — Continuous	Ic	600		mAdo

		Each Transistor	Four Transistors Equal Power	
Total Power Dissipation (a T _A = 25°C Derate above 25°C	PD	0.52 4.2	1.0	Watts mW/°C
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	0.8 6.4	2.4 19.2	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

CASE 751B-03 SO-16 PIN CONNECTIONS DIAGRAM QUAD GENERAL PURPOSE TRANSISTOR PNP SILICON

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	MMPQ2907 MMPQ2907A	V(BR)CEO	40 60	_	=	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V(BR)CBO	60	-	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	5.0	_	_	Vdc
Collector Cutoff Current (VCB = 30 Vdc, $I_E = 0$) (VCB = 50 Vdc, $I_E = 0$)	MMPQ2907 MMPQ2907A	ICBO	_	_	50 10	nAdc
Emitter Cutoff Current (V _{CB} = 3.0 Vdc, I _C = 0)		IEBO	_		50	nAdc
ON CHARACTERISTICS						
DC Current Gain(1) $ \begin{aligned} &\text{(IC} = 100 \; \mu\text{Adc, V}_{\text{CE}} = 10 \; \text{V)} \\ &\text{(IC} = 1.0 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{V)} \\ &\text{(IC} = 10 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{V)} \\ &\text{(IC} = 150 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{V)} \\ &\text{(IC} = 300 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{V)} \\ &\text{(IC} = 500 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{V)} \end{aligned} $	MMPQ2907A MMPQ2907A MMPQ2907/2907A MMPQ2907/2907A MMPQ2907/2907A MMPQ2907/2907A	hFE	75 100 75/100 100 30/50 50	_ _ _ _	300	_
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	MMPQ2907 MMPQ2907 MMPQ2907A	VCE(sat)	=	= 1	0.4 1.6 1.6	Vdc
Base-Emitter Saturation Voltage(1) (IC = 150 mAdc, IB = 15 mAdc) (IC = 300 mAdc, IB = 30 mAdc) (IC = 500 mAdc, IB = 50 mAdc)	MMPQ2907 MMPQ2907 MMPQ2907A	VBE(sat)	=		1.3 2.6 2.6	Vdc

ELECTRICAL CHARACTERISTICS (Continued)

Characteristic			Symbol	Min	Тур	Max	Unit
DYNAMIC CHARACTERISTICS		Y AND THE					
Current-Gain — Bandwidth Product(1) (I _C = 50 mAdc, V _{CF} = 20 Vdc, f = 100 MHz)	Sinti	APADDODESA	fT	Symbol	350	HHTAE MU	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kHz)	Vdc	00	C _{ob}	0937	6.0 _{egs}		pF
Input Capacitance (VBE = 2.0 Vdc, I _C = 0, f = 100 kHz)	alav	0.8	C _{ib}	89V	20	agettoV sas	pF
SWITCHING CHARACTERISTICS	SBAM	00		21	aubumino	Durent 4 C	respettoD
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ mAdc}, I_{B1} = 15 \text{ mA})$	dc)	Four Translators	ton	-	30	-	ns
Turn-Off Time		Equal Power	toff	-	100	_	ns
$(V_{CC} = 6.0 \text{ Vdc}, I_{C} = 150 \text{ mAdc}, I_{B1} = I_{B2} =$	15 mAdc)		0.52	09	DW TA = 28°C	MIRGIPALO 144	Total Po-
) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle :	= 2.0%.	0.8	4.2			shove 25°C	steme
GENERAL PURPOSE TRANSISTOR							

AUSTERNAMEN STATES

MAXIMUM RATINGS

WAXIMOW NATINGS			
Rating	Symbol	Value (1)	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCB	40	Vdc
Emitter-Base Voltage	VEB	5.0	Vdc
Collector Current — Continuous	IC IC	1.0	mAdc

	B 82	Each Transistor	Four Transistors Equal Power	Back entrator
Power Dissipation (a T _A = 25°C Derate above 25°C	PD	0.52 4.2	1.2 9.6	Watts mW/°C
Power Dissipation (<i>a</i> T _C = 25°C Derate above 25°C	PD	1.0	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		eg ∘C

CASE 751B-03 SO-16 PIN CONNECTIONS DIAGRAM OUAD MEMORY DRIVER TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					2,1	
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	D 10 (1 9) V	V(BR)CEO	40			Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	Pasinaly	V(BR)CBO	40	-		Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	0831881/	V(BR)EBO	5.0			Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	0.40	СВО	_	-	200	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)	170	IEBO		_	200	nAdc
ON CHARACTERISTICS		25.00 1979			101	
DC Current Gain(1) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc)		ESSE hFE LT	20	1915-	_	_
Collector-Emitter Saturation Voltage(1) (I _C = 500 mAdc, I _B = 50 mAdc)	Vergour	V _{CE(sat)}	_	0.23	0.5	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 500 mAdc, I _B = 50 mAdc)	78.07 EEV	V _{BE(sat)}	_	0.9	1.2	Vdc
DYNAMIC CHARACTERISTICS				50(3)(e, nahije .	115 7
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	11	PSTEC fT /MM MMP 0 strys	lahmi Diji	190	* 1 1 1 4 1 1 1 1 1	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	Here	C _{ob}	_	10	- 1-1	pF
Input Capacitance (V _{BE} = 0.5 Vdc, I _C = 0, f = 100 kHz)	1949 J	Cib	_	55	-	pF
SWITCHING CHARACTERISTICS				COTTAGE	5) 10%	
Turn-On Time (I _C = 500 mAdc, I _{B1} = 50 mAdc)		ton	-	20	_	ns
Turn-Off Time (I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAdc)	ne)	toff	-	60		ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMUM RATINGS Symbol MMPQ3725 MMPQ3725A Unit Rating Collector-Emitter Voltage VCEO 40 50 Vdc Collector-Emitter Voltage 60 70 Vdc VCES Emitter-Base Voltage VEB 5.0 Vdc Collector Current — Continuous IC 1.0 Adc Operating and Storage Junction Temperature Range TJ, Tstg -55 to +150 °C

		Each Transistor	Four Transistors Equal Power	Fach to sistes
Total Power Dissipation (a T _A = 25°C Derate above 25°C	PD	0.6 4.8	1.4 11.2	Watts mW/°C
Power Dissipation (a T _C = 25°C Derate above 25°C	PD	1.0 8.0	2.5 2.0	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C



CORE DRIVER TRANSISTOR

NPN SILICON

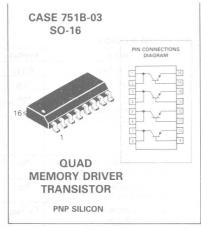
ELECTRICAL CHARACTERISTICS (T _A = 25°C unless otherwise no	noted.	.)
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Characteri	stic	Indaug	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS							
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	OP.	MMPQ3725 MMPQ3725A	V(BR)CEO	40 50	down Voltage	blaseral netturn	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, V _{BE} = 0)	92	MMPQ3725 MMPQ3725A	V(BR)CES	60 70	wn Voltaga	ebalean8 cas	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		Оаз(яв)У	V(BR)EBO	5.0	voltage	wdb/sand ea	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0)		080)	ICBO	-	- 10	0.5	μAdc
ON CHARACTERISTICS(1)						tentone l'ive	O setting
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)		MMPQ3725 MMPQ3725A	hFE	35 40	75 80	200	= 30 V1
$(I_C = 500 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc})$		MMPQ3725 MMPQ3725A		25 30	45 50	(Lines) Solvania Vos	Current (tg = 51
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)			V _{CE} (sat)	(f	0.32	0.45	
Base-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)	Total	VERESARY	V _{BE(sat)}	0.8	0.9 loV	1.0	
DYNAMIC CHARACTERISTICS					STICS	MENDARAHI	OBMANY!
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 10	00 MHz)	MMPQ3725 MMPQ3725A	fT	100 (4)(2)	275 250	n → Bandwi mA• LVGE	
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)		deO	C _{ob}	(5)	5.1 M 001 = 1.0		pF pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)		tii D	C _{ib}	(s)	62	= ahoutit = ahout t	pF
SWITCHING CHARACTERISTICS					RISTRES	CHARACTE	WITCHIEL
Turn-On Time	(off) = 3	.8 Vdc)	ton		20 labAm 0d =	ral pbins	ns
Turn-Off Time — (I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAd	dc)	ffol	toff	(ols/kri	50	sm rgl_pbAm	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	yanti Value ando	Unit
Collector-Emitter Voltage	VCEO	40 04	Vdc
Collector-Base Voltage	V _{CB}	60 V 40 na	Vdc
Emitter-Base Voltage	VEB	5.0	Vdc
Collector Current — Continuous	lc	70 Acri 1.5 509	mAdd

	1000	Each Transistor	Four Transistors Equal Power	ras3 rapsist
Power Dissipation (a TA = 25°C Derate above 25°C	PD	0.6 4.8	1.4	Watts mW/°C
Power Dissipation (a T _C = 25°C Derate above 25°C		1.0 8.0	2.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 t	o + 150	°C



Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			3	TERR T M	
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO	40	ed a T AOSE	nog C' es	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	40	aci (77 - 77	5 T	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	m= no	· · · · =	Vdc
Collector Cutoff Current (VCB = 30 Vdc, I _E = 0)	ICBO	-	_	100	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	IEBO	-	-	100	nAdc
ON CHARACTERISTICS(1)			THE	9 4 5 3 7 3	
DC Current Gain (IC = 150 mAdc, V _{CE} = 1.0 Vdc) (IC = 500 mAdc, V _{CE} = 2.0 Vdc) (IC = 1.0 Adc, V _{CE} = 2.0 Vdc)	hFE	35 30 20	70 65 35		_
Collector-Emitter Saturation Voltage (IC = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)	V _{CE} (sat)	_ =	0.3	0.55 0.9	Vdc
Base-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)	V _{BE} (sat)	_	0.9 1.0	1.25 1.4	Vdc
DYNAMIC CHARACTERISTICS			49	Er re- L	
Current-Gain — Bandwidth Product(1) (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	11141111	275		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{ob}	_	9.0	-	pF
Input Capacitance (VBE = 0.5 Vdc , IC = 0 , f = 100 kHz)	C _{ib}	-	55	and Till o	pF
SWITCHING CHARACTERISTICS				Y line	
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 1.0 \text{ Adc}, I_{B1} = 100 \text{ mAdc}, V_{BE(off)} = 2.0 \text{ Vdc})$	ton	_	25		ns
Turn-Off Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 1.0 \text{ Adc}, I_{B1} = I_{B2} = 100 \text{ mAdc})$	toff	pl. vii ytuti	60	ST DE TO	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

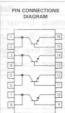
Rating	Symbol		Value		Unit
Collector-Emitter Voltage	VCEO		40		Vdc
Collector-Base Voltage	VCB		60		Vdc
Emitter-Base Voltage	VEB		6.0		Vdc
Collector Current — Continuous	Ic	abaam	200	9.1	mAdd

		Each Transistor	Four Transistors Equal Power	fach ransist
Total Power Dissipation (a T _A = 25°C Derate above 25°C	PD	0.4 3.2	0.72 6.4	Watts mW/°C
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	0.66 5.3	1.92 15.4	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

MMPQ3904

CASE 751B-03 SO-16





QUAD AMPLIFIER/SWITCH TRANSISTOR

NPN SILICON

ic ladinke		Symbol	Min	Тур	Max	Unit
				5.	RACTERISTN	- H3 440
VIBRICEO .		V(BR)CEO	40	elloV <u>n</u> yveb# (0 =	Emili <u>a</u> t Bies 0 mAda lg	Vdc
082(RS)V		V _(BR) CBO	60	own <u>Vo</u> ltage 0)	Bess <u>B</u> reake 0 µAdo, lg	Vdc
083(88) ^V		V(BR)EBO	6.0	wn V <u>oit</u> age 01	ase <u>Brasimo</u> C _{ju} A <u>do</u> , fo =	Vdc
CBO		ICBO	_	In (0. =	50	nAdc
083		IEBO	_	10 =	50	nAdc
				(1)8	DITERRETTO	AHD MC
		hFE	30 50 75		V Jah <u>a</u> m 00	(10 = 10) (10 = 10) (10 = 10)
VGE(sar)		VCE(sat)	- *	0.1 55Am 58	0.2	Vdc
VBE(sat)		V _{BE} (sat)	_	0.65	0.85	Vdc
				Johnson Oct	e al alva n	J = 00
MHz)		fT	250			MHz
		C _{ob}	SHW USF -	2.0	4.0	pF
000		Cib	(sti	gor 4.0 0	8.0	pF
-01-			(4)42	001 - 10 -	n.S. Vdc. ke	= . projet = . projet)
1.0 mAdc)		ton	-			
10	2,0 Vdo)	toff	Am Qui = 1	136	Su voute	ns
	083045)V 0831 0831 0831 0831 0831 0831 0831 0831	OSO(AS) V OSO(AS	V(BR)CEO V(BR)CBO V(BR)CBO V(BR)EBO ICBO ICBO V(BR)EBO ICBO ICBO ICBO ICBO ICBO ICBO ICBO IC	V(BR)CEO 40 V(BR)CEO 60 V(BR)CBO 6.0	V(BR)CEO 40	V(BR)CEO 40

MMbde200

CASE 7518-03

MAXIMUM RATINGS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	40	34	Vdc
Collector-Base Voltage	VCB	40	26	Vdc
Emitter-Base Voltage	VEB	5.0		Vdc
Collector Current — Continuous	lc	200		mAdo

		Each Transistor	Four Transistors Equal Power	rion I
Power Dissipation (<i>u</i> T _A = 25°C Derate above 25°C	PD	0,4 3.2	0.72 6.4	Watts mW/°C
Power Dissipation (<i>u</i> T _C = 25°C Derate above 25°C	PD	0.66 5.3	1.92	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg} -55 to +150		°C	

MMPQ3906 CASE 751B-03 SO-16 PIN CONNECTIONS DIAGRAM

QUAD AMPLIFIER/SWITCH TRANSISTOR

PNP SILICON

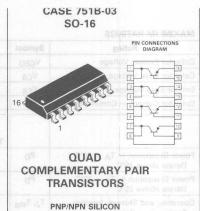
ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic (Characteristic Characteristi (Characteristic (Characteristi (Characteristi (Ch	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				476 PH 2 11	
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	V(BR)CEO	40	gr (/12 1	And — 1	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	V _(BR) CBO	40	nym a b 'i ang		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	V(BR)EBO	5.0	-	0115/— 1113 — — 1	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	ICBO	-	_	50	nAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, I _C = 0)	IEBO	-	-	50	nAdc
ON CHARACTERISTICS(1)				e il right il	
DC Current Gain ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	hFE	40 60 75	160 180 200	-	· · · · · ·
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)	_	0.1	0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}	-	0.65	0.85	Vdc
DYNAMIC CHARACTERISTICS			POSTR	NETT THE	
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	200	250	- <u>-</u>	MHz
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_E = 0$, $f = 140 \text{ kHz}$)	C _{ob}	- 454	3.3	4.5	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 140 kHz)	Cib		4.8	10	pF
SWITCHING CHARACTERISTICS		AND THE RESERVE OF THE PERSON			
Turn-On Time (I _C = 10 mAdc, V _{BE(off)} = 0.5 Vdc, I _{B1} = 1.0 mAdc)	ton	- 30 <u>0</u> ga2	43		ns
Turn-Off Time (I _C = 10 mAdc, I _{B1} = I _{B2} = 1.0 mAdc)	toff	_	155	-	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMUM RATINGS Value Rating Symbol Unit Collector-Emitter Voltage 40 Vdc **VCEO** 40 Collector-Base Voltage VCBVdc 5.0 Emitter-Base Voltage VEB Vdc IC 200 Collector Current — Continuous mAdc

		Each Transistor	Four Transistors Equal Power	Each ansistes
Total Power Dissipation (a T _A = 25°C Derate above 25°C	PD	0.4 3.2	0.72 6.4	Watts mW/°C
Total Power Dissipation (a T _C = 25°C Derate above 25°C	T PD	0.66 5.3	1.92 15.4	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

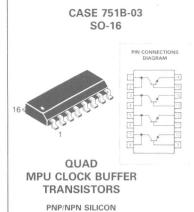


HRU XRM GVT Char	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					стенвтю	HE CHARA
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	08	V(BR)CEO	V(BR)CEO	aga 40 mwc	nitter Breakd mAdc, ig =	
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_E = 0)$	- 40	V(9R)(30	V(BR)CBO	40 oV m	se Br astiddyd Ado, Ig = 0	
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	5,0	У ВЗІВВІЕВО — — — — — — — — — — — — — — — — — — —	V(BR)EBO	5.0	s Bre zi dowa "Adc. Ic. = 0	
Collector Cutoff Current (VCB = 30 Vdc, I _E = 0)		0801	ІСВО	- (1661 50 Hot. 1 = gl.,36V 0	
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	-	Q83 ^l	IEBO	- (0	50.0 ft	
ON CHARACTERISTICS(1)					CTENSTICS	NI CHALLA
DC Current Gain (I _C = 0.1 mAdc, V_{CE} = 1.0 Vdc) (I _C = 1.0 mAdc, V_{CE} = 1.0 Vdc) (I _C = 10 mAdc, V_{CE} = 1.0 Vdc)	40 60 76	3311	hFE	50 70	Gain mAde, VCB mAde—VCB nAde—VCB =	
Collector-Emitter Saturation Voltage $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$	7	VCE(sat)	VCE(sat)	aga lla V nox (obAm 0	0.25	
Base-Emitter Saturation Voltage $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$		VBE(sat)	V _{BE} (sat)	Voltage Voltage Voltage	0.912 T	
DYNAMIC CHARACTERISTICS				smos	URSTOARAK	Olivatayii c
Current-Gain — Bandwidth Product(1) ($I_C = 10 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 1$	00 MHz)	T ²	the the tensor of the tensor o	200	n — G u ndwid mAda, Vag	
Output Capacitance $(V_{CB} = 5.0 \text{ Vdc}, I_{E} = 0, f = 100 \text{ kHz})$		Сов	Cob	0, f = 140 ki	4.5 scioc = gl. obV 0.	ged pFm/0
Input Capacitance $(V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$	PN NP		C _{ib}	0, f40 ki	The second secon	osus ipF ugn 0 = ggV)

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

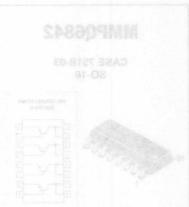
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	30	Vdc
Collector-Base Voltage	VCB	30	Vdc
Emitter-Base Voltage	VEB	4.0	Vdc
Collector Current — Continuous	I _C	200	mAdd

		Each Transistor	Four Transistors Equal Power	
Total Power Dissipation (α T _A = 25°C Derate above 25°C	PD	0.4 3.2	0.72 6.4	Watts mW/°C
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	0.66 5.3	1.92 15.4	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	– 55 t	o +150	°C



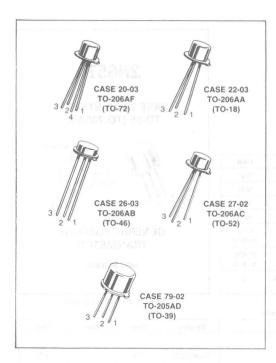
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO	30	_		Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	30	-	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	4.0	_		Vdc
Collector Cutoff Current $(V_{CB} = 20 \text{ Vdc}, I_E = 0)$	ICBO	_	_	50	nAdc
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)	IEBO	_	_	50	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain	hFE	30 50 70	_	=	_
Collector-Emitter Saturation Voltage (IC = 0.5 mAdc, IB = 0.05 mAdc, 0° C \leq T \leq 70 $^{\circ}$ C)	V _{CE(sat)}	_	0.05	0.15	Vdc
Base-Emitter Saturation Voltage (I _C = 0.5 mAdc, I _B = 0.05 mAdc)	V _{BE(sat)}	_	0.65	0.9	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain — Bandwidth Product(1) (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	200	350	_	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)	C _{ob}	-	3.0	4.5	pF
Input Capacitance $(V_{EB}=0.5\ Vdc, I_{C}=0, f=100\ kHz)$ PNP NPN	C _{ib}	=	5.0 4.0	10 8.0	pF
SWITCHING CHARACTERISTICS ($T_A = 25^{\circ}C$, $V_{CC} = 5.0 \text{ Vdc}$)					
Propagation Delay Time (50% Points TP1 to TP3) (50% Points TP2 to TP4)	^t PLH ^t PHL	_	15 6.0	25 15	ns
Rise Time (0.3 V to 4.7 V, TP3 or TP4)	t _r	5.0	25	35	ns
Fall Time (4.7 V to 0.3 V, TP3 or TP4)	tf	5.0	10	20	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 $\mu s,$ Duty Cycle \leq 2.0%.



			MAXIMUM HATINGS

Sunemi-Gain — Bendwidth Frodeoff1) (fig. = 10 mAde, Vog. ~ 20 Vde, f. + 100 MHz)			



Motorola's metal-can transistor product offering includes: general purpose, switching, high voltage, choppers, Darlingtons, low noise amplifiers and RF amplifiers.

A variety of package options are available: TO-18, TO-46, TO-52, TO-72, and TO-39.

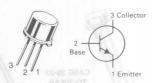
Many devices contained in this section are also available with high reliability MIL-S-19500 processing. JAN, JANTX, JANTXV, and JANS qualified devices are so noted on the following data sheets.

Metal Transistors

4

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	100	Vdc
Collector-Base Voltage	VCBO	100	Vdc
Emitter-Base Voltage	VEBO	8.0	Vdc
Collector Current — Continuous	IC	0.5	Adc
Total Device Dissipation (α T _A = 25°C Derate above 25°C	PD	1.0 5.7	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	4.0 22.8	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3498 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

	Symbol	Min	Max	Unit
	V(BR)CEO	100	- T	Vdc
	V(BR)CBO	100	manufacture eater	Vdc
	V(BR)EBO	A CONTRACTOR OF THE	qо во в орец	
lowing data	led on the for	es are so no	alitied device	JAINS OU
	hFE	30	90	,219
	VCE(sat)	-	4.0	Vdc
	h _{fe}	-	0.5	k ohm
	TO-46, TO	V(BR)CEO V(BR)CBO V(BR)EBO ICBO hFE VCE(sat)	V(BR)CEO 100 V(BR)CBO 100 V(BR)EBO 8.0 ICBO — hFE 30 VCE(sat) —	V(BR)CEO 100 — V(BR)CBO 100 — V(BR)EBO 8.0 — ICBO — 10 hFE 30 90 VCE(sat) — 4.0

⁽¹⁾ Pulse Test: Pulse Length = 300 μ s, Duty Cycle \leq 2.0%.

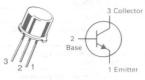
CASE 79-02, STYLET TO-39 (TG-20SAU)

MAXIMUM RATINGS

WAXIWOWTATINGS					
Rating	Symbol	Value	Unit		
Collector-Emitter Voltage	VCER	W 40 0	Vdc		
Collector-Base Voltage	VCBO	Wm 60 8 8	Vdc		
Emitter-Base Voltage	VEBO	5.0	™ Vdc e		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.6 4.0	Watt mW/°C		
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	2.0	Watts mW/°C		
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C		

2N697

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N2218 for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			Sulfania L	
Collector-Emitter Breakdown Voltage(1) (I _C = 100 mAdc, R _{BE} = 10 ohms)	V(BR)CER	40		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc$, $I_E = 0$)	V(BR)CBO	60		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)	V(BR)EBO	5.0		Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 30 Vdc, I _E = 0, T_A = 150°C)	СВО	_	1.0 100	μAdc
ON CHARACTERISTICS		(SOUTH)		
DC Current Gain(1) (I _C = 150 mAdc, V _{CE} = 10 Vdc)	hFE	40	120	_
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	VCE(sat)	DESIGNATION OF	1.5	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	V _{BE(sat)}	n'i surdi o	1.3	Vdc
SMALL-SIGNAL CHARACTERISTICS	rielan ne	1.36122.0		
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0)	C _{obo}		35	pF
Small-Signal Current Gain (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	h _{fe}	2.5	- 10	MHz
\ Dulas Tasti Dulas Lanath = 12 and Duty Coda = 2.00/				

⁽¹⁾ Pulse Test: Pulse Length ≤ 12 ms, Duty Cycle ≤ 2.0%.

Rating Taken	Symbol	Value	Unit
Collector-Emitter Voltage	VCER	80	Vdc
Collector-Base Voltage	VCBO	120	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Total Device Dissipation (a: T _A = 25°C Derate above 25°C	PD	0.6 4.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.0	Watts mW/°C
Operating and Storage Temperature Temperature Range	TJ, T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max 8	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	75	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	250	°C/W

2N699

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

tinU xxxv nike Char	acteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			- 2	DITERISTICS	OFF CHAF
Collector-Emitter Breakdown Voltage (1) $(I_C = 100 \text{ mAdc}, R_{BE} \le 10 \text{ ohms})$	D(AS)V	V(BR)CER	80	indte <u>r Break</u> û niAdo, Rgi	Vdc
Collector Cutoff Current (VCB = 60 Vdc, I _E = 0) (VCB = 60 Vdc, I _E = 0, T _A = 150°C)		Ісво	epatioV mv	2.0	μAdc
Emitter Cutoff Current (VEB = 2.0 Vdc, IC = 0)	0601	lEBO	10	100	μAdc
ON CHARACTERISTICS			(0	30 Vd6, 1g =	= 80VI
DC Current Gain (1) (I _C = 150 mAdc, V _{CE} = 10 Vdc)		hFE	40	120	ON CHAS
Collector-Emitter Saturation Voltage (1) (I _C = 150 mAdc, I _B = 15 mAdc)		VCE(sat)	(sbV 0) =	5.0 so l	Vdc
Base-Emitter Saturation Voltage (1) (I _C = 150 mAdc, I _B = 15 mAdc)	SOE(68	VBE(sat)	tion <u>V</u> oltage 15 m/Jde)	al ,obAni 0	
SMALL-SIGNAL CHARACTERISTICS	Vaeius		Voltage(1)	ter Saturation	Base-Ernit
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20	MHz)	fT	50	GNAL CHAR	MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 100 kHz)	odo	C _{obo}	(0	20 10 80 1 30 V 00	n goVI
Input Impedance (IC = 1.0 mAdc, VCB = 5.0 Vdc, f = 1		hib ox	20	30 Am	Ohms
(I _C = 5.0 mAdc, V _{CB} = 10 Vdc, f = 1.) Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.) (I _C = 5.0 mAdc, V _{CB} = 10 Vdc, f = 1.)	.0 kHz)	h _{rb}	am S—ar Att	2.5 3.0	X 10-4
Small Signal Current Gain		h _{fe}	35 45	100	_
Output Admittance (I _C = 1.0 mAdc, V_{CB} = 5.0 Vdc, f = 1 (I _C = 5.0 mAdc, V_{CB} = 10 Vdc, f = 1.		h _{ob}	0.05	0.5 1.0	μmhos

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

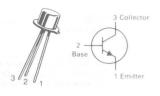
WAXIWOW RATINGS		1			
Rating		Symbol	Value	Unit	
Collector-Emitter Voltage 2N706A,B		VCEO	15	Vdc	
Collector-Emitter Voltage(1)		VCER	20	Volts	
Collector-Base Voltage		VCBO	25	Volts	
Emitter-Base Voltage	2N706 2N706A 2N706B	VEBO	3.0 5.0 5.0	Volts	
Collector Current	2N706,A,B	IC	50	mA	
Total Device Dissipation (a T _A = 25°C Derate above 25°C		PD	0.3 2.0	Watt mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C		PD	1.0 6.67	Watts mW/°C	
Total Device Dissipation (a T _C = 100°C Derate above 100°C		PD	0.5 (A riedwi	Watt	
Operating and Storage Junct Temperature Range	ion	TJ, T _{stg}	-65 to +200	°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	150	°C/W
Thermal Resistance, Junction to Ambient 2N706A,B	$R_{\theta}JA$	500	°C/W

2N706,A,B

(2N706 JAN AVAILABLE) CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N2368 for graphs.

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	wa. 0	V(BR)CEO	15		Vdc
Collector-Emitter Breakdown Voltage(2) (R = 10 ohms, I _C = 10 mAdc)		V(BR)CER	20		Vdc
Collector Cutoff Current ($V_{CB} = 15 \text{ Vdc}$, $I_{E} = 0$) ($V_{CB} = 15 \text{ Vdc}$, $I_{E} = 0$, $T_{A} = 150^{\circ}\text{C}$) ($V_{CB} = 25 \text{ Vdc}$, $I_{E} = 0$)	2N706A, 2N706B	Ісво	_	0.5 30 10	μAdc
Collector Cutoff Current (VCE = 20 Vdc, RBE = 100k)	2N706A, 2N706B	CER	_	10	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc , $I_C = 0$) (VEB = 5.0 Vdc , $I_C = 0$)	2N706 2N706A, 2N706B	IEBO	_	10 10	μAdc
ON CHARACTERISTICS					
DC Current Gain(2) $(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N706 2N706A, 2N706B	hFE	20 20	 60	
Collector-Emitter Saturation Voltage(2) $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$	2N706, 2N706A 2N706B	VCE(sat)	_	0.6	Vdc
Base-Emitter Saturation Voltage(2) (I _C = 10 mAdc, I _B = 1.0 mAdc)	2N706 2N706A, 2N706B	V _{BE} (sat)	— 0.7	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product ($V_{CE} = 15 \text{ Vdc}, I_E = 10 \text{ mAdc}, f = 100 \text{ MHz}$)		fT	200	_	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0) (V _{CB} = 10 Vdc, I _E = 0)	2N706A, 2N706B 2N706	C _{obo}	_	5.0 6.0	pF
Magnitude of Forward Current Transfer Ratio, Common- (V _{CE} = 15 Vdc, I _E = 10 mAdc, f = 100 Mhz) (V _{CE} = 10 Vdc, I _E = 10 mAdc, f = 100 MHz)	-Emitter 2N706 2N706A,B	hfe	2.0 2.0	_	-

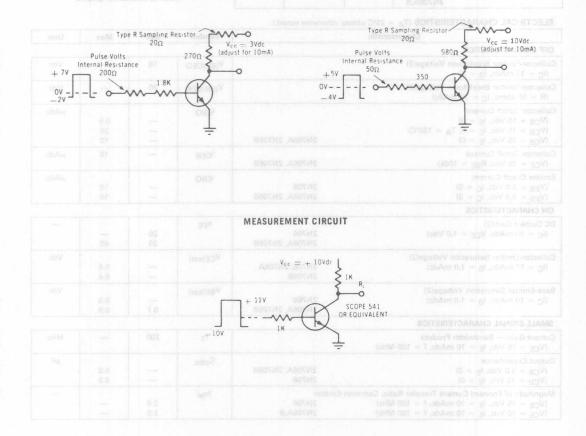
ELECTRICAL	CHARACTERISTICS	(continued) (TA =	25°C unless	otherwise noted.)

Characteristic	anov 1	OF.	S	ymbol	Min	Max	Unit
Collector Base Time Constant (V _{CF} = 15 Vdc, I _F = 10 mAdc, f = 300 MHz)			Veso	rb	pariac	50	8 ohms
Storage Time	2N	706B	100	ts	ABOSS HE	25	ns
Turn-On Time (I _{B1} = 3.0 mA, I _{B2} = 1.0 mA)	han	0.6	31	t _{on}	2N7Q66 2N7Q6A	40	ns Collector
Turn-Off Time (I _{B1} = 3.0 mA, I _{B2} = 1.0 mA)	Wate		ad	^t off	285 - 75 -	75 × 0 × 0	o valns dol
Charge Storage Time Constant(2)		706 706A,B	gq -e	T _S	76 = 25°C	60.	Cerate Description

- (1) Refers to collector breakdown voltage in the high current region when $R_{be} = 10~\Omega$
- (2) Pulse Test: Pulse Width \leq 12 μ s, Duty Cycle \leq 2.0%.
- (3) Switching Times Measured with Tektronix Type R Plug-In (50 Ω Internal Impedance).

SWITCHING TIME TEST CIRCUIT

STORAGE TIME TEST CIRCUIT



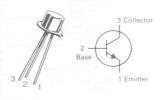
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Emitter Voltage	VCER	20	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	lc	limited by	P _D only
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	360 2.1	mW mW/°C
Total Device Dissipation (a) $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above 25°C Derate above 100°C	PD	1.2 680 6.9 6.9	Watts mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	S °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	145	°C/W

2N708

JAN, JTX AVAILABLE CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N2368 for graphs.

ELECTRICAL	. CHARACTERISTICS	(TA =	25°C unless	otherwise	noted.)
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Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (I _C = 30 mAdc, R _{BE} ≤ 10 ohms)	VCER(sus)	20	(d, -	Vdc
Collector-Emitter Sustaining Voltage (IC = 30 mAdc, IB = 0)	VCEO(sus)	15	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 1.0 \mu Adc, I_E = 0$)	V(BR)CBO	40	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0		Vdc
Collector Cutoff Current (V _{CE} = 20 Vdc, V _{BE} = 0.25 Vdc, T _A = +125°C)	ICEX	_	10	μAdc
Collector Cutoff Current $(V_{CB} = 20 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 20 \text{ Vdc}, I_C = 0, T_A = 150^{\circ}\text{C})$	ICBO		0.025 15	μAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	IEBO	_	0.08	μAdc
ON CHARACTERISTICS				
DC Current Gain	hFE	15 30 15	120	_
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 7.0 \text{ mAdc}$, $I_B = 0.7 \text{ mAdc}$, $T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$)	VCE(sat)	10 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -	0.4 0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 7.0 mAdc, I _B = 0.7 mAdc, T _A = -55°C)	V _{BE} (sat)	0.72	0.80 0.90	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	f _T	300	131111	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, 100 kHz \leq f \leq 1.0 MHz)	C _{obo}	en interes	6.0	pF
Extrinsic Base Resistance (IC = 10 mAdc, V_{CE} = 10 Vdc, f = 300 MHz)	r _b ′	_	50	ohms
SWITCHING CHARACTERISTICS				
Storage Time $(I_C = I_{B1} = I_{B2} = 10 \text{ mAdc})$	ts	_	25	ns
Turn-On Time	ton	_	40	ns
Turn-Off Time	toff	_	70	ns

SUZUS

JAN, JTX AVAILABLE

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage(1)	VCER	40	Vdc
Collector-Base Voltage	V _{CBO}	60	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	I _C	Wm 500	mA
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.4 2.66	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.5 10	Watts mW/°C
Total Device Dissipation (a T _C = 100°C	PD	0.75	Watt
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +175	°C

2N718

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N2218 for graphs.

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	*			2	OTZIKSTOW	UAHO 170
Collector-Emitter Breakdown Volta (I _C = 100 mAdc, pulsed; R _B \leq 1		Ade, Rgg = 10 ahms)	VCER(sus)	and 40	men8 romani	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	OSC(RR)V	(0 = g) of	V(BR)CBO	60	obvlestě sast	Vdc
Emitter-Base Breakdown Voltage (I _E = 1.0 mA, I _C = 0)	VESKIEBO	ic = 0)),25 Vda, T _A = +125°C)	V _{(BR)EBO}	90 5 lov n \$ = 30V) s	se Br <u>eakdow</u> Jutoff Cumer	Vdc
Collector Cutoff Current $(V_{CB} = 30 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 30 \text{ Vdc}, I_E = 0, T_A = 19)$	080 ¹	(0°09) - AT	ICBO	(V _{CB} = 2 (V _{CB} = 2 0.6 = 2eV)	1.0	μAdc
ON CHARACTERISTICS					ACTERISTICS	OM CHAR
DC Current Gain (I _C = 150 mAdc, V _{CE} = 10 Vdc	384		hFE	40	120	norma JO
Collector-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc			VCE(sat)	= 1.9¥/dc)(1 = 1.6 Vdc; 1	1.5 Am	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc	VCE(sat)		V _{BE(sat)}	atio n V oltaga 1.0-mAde)	mil 8.15 auur = gl.,bbA.mr	tot Vdc
SMALL-SIGNAL CHARACTERISTIC	s	5 + 128 C)	37 O'88 - = A	abam 5.0	gli əbAm (7 = 28
Output Capacitance (VCB = 10 Vdc, f = 100 kHz, I _E	(0 = 0)		C _{obo}	1.0 mAdc)	35	pF
Input Capacitance (VBE = 0.5 V, f = 100 kHz, I _C =	0)		C _{ibo}	OLTENIETIC:	80	pF
Small-Signal Current Gain (IC = 50 mAdc, VCE = 10 Vdc,	f = 20 MHz)		h _{fe}	2.5	n — danov mAdo, Vos	Janearo:
1) Pulse Test: PW ≤ 300 μs, Duty 0	ycle ≤ 2.0%.		(sHM 0.1 > 1	0, 100 kHz =	pacitarine 10 Vdc, lg =	

Rating	Symbol	2N718A 2N956	2N1711	Unit
Collector-Emitter Voltage	VCER	5	0	Vdc
Collector-Base Voltage	VCBO	7	Vdc	
Emitter-Base Voltage	VEBO	7.0 AST		Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	500 2.86	800 4.57	mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.8 3.0 10.3 17.15		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}		0 +200	^s °C



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.*

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I _C = 100 mAdc, pulsed; R _{BE} ≤ 10 ohms)	ABINAS	VCER(sus)	50			Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	2Nas6 2M12111	V(BR)CBO	75		_	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μ Adc, I _C = 0)		V _{(BR)EBO}	7.0	-	_	Vdc
Collector Cutoff Current $(V_{CB} = 60 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 60 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$		ICBO	=	0.001	0.01 10	μAdc
Emitter Cutoff Current $(V_{BE} = 5.0 \text{ Vdc}, I_{C} = 0)$	2N718A, 2N956, 2N1711	IEBO	_	_	0.010 0.005	μAdc
ON CHARACTERISTICS						
DC Current Gain ($I_C = 0.01 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$)	2N956, 2N1711	hFE	20	_	_	_
$(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N718A, 2N956, 2N1711		20 35	_	=	
$(I_{C} = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N718A, 2N956, 2N1711		35 75	_	_	
$(I_{C} = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, T_{A} = -55^{\circ}\text{C})$	2N718A, 2N956, 2N1711		20 35	_	_	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N718A, 2N956, 2N1711		40 100	_	120 300	
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N718A, 2N956, 2N1711		20 40	_	_	
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)		VCE(sat)	_	0.24	1.5	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)		V _{BE(sat)}		1.0	1.3	Vdc

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

		J				бунный	IVIIII	тур	iviax	Unit
SMALL-SIG	NAL CHARA	ACTERISTIC	S ee 32	43						
Current-Gair (I _C = 50 n		dth Product = 10 Vdc, f			2N718A, 2N956, 2N1711	fT	60 70	300 300	_	MHz
Output Capa (V _{CB} = 10	Citarioc	0, f = 100 l				C _{obo}	-	4.0	25	pF
Input Capaci (VBE = 0.		0, f = 100	kHz)		109	C _{ibo}		20	80	pF
	mAdc, V _{CB}	= 5.0 Vdc,			50 201711 Un	Work did 2018	24	- 1 - 3	34,531	ohms
Voltage Fee	dback Ratio		LMY	3	2N718A,	hrb	4.0		3.0	X 10-4
(IC = 1.0		= 5.0 Vdc,			2N956, 2N1711	PD 601	- 018	0 = A ² 0	5.0	tal Davice Darate ab
	JEUTHU	= 10 Vdc, 1	lab	z) am	2N718A, 2N956, 2N1711	Pp 13	_ 3/8	$(0,\overline{1}_{\mathbb{C}}=2$	3.0 5.0	rat Device
Small-Signa (I _C = 1.0		ain = 5.0 Vdc,		z)	2N718A, 2N956, 2N1711	hfe glaT .t.	30 50	lunction	100	erating a femperati
(I _C = 5.0	mAdc, V _{CE}	= 10 Vdc, f	f = 1.0 kH;	z)	2N718A, 2N956, 2N1711		35 70	CTERISTII	150	DISTORL
	mAdc, V _{CB}	= 5.0 Vdc, = 10 Vdc,				h _{ob}	0.05 0.05	da	0.5	μmhos
Noise Figure	9	= 10 Vdc, 1	0.0	VCER(sus)	2N718A,	NF	(émirlo Df	lown Voltage sed; Rgg ≤	luq al-Am	dB of
SbV			dV.	VERICEO	2N956, 2N1711			(0)	8.0	031 = D
								10 Vde)		
									Ade, Ves =	

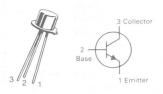
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	1171L 80 =	Vdc Vdc
Collector-Emitter Voltage	VCER	100	Vdc
Collector-Base Voltage	VCBO	120	Vdc
Emitter-Base Voltage	VEBO	7.0	Vdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.5 2.86	Watt mW/°C
Total Device Dissipation $(a T_C = 25^{\circ}C)$ Derate above 25°C	PD	1.8 24 10.3	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

THERIVIAL CHARACTERISTICS			100
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	97	°C/W

2N720A

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (I _C = 100 mAdc, R _{BE} ≤ 10 ohms)	VCER(sus)	100	_	Vdc
Collector-Emitter Sustaining Voltage(1) (IC = 30 mAdc, IB = 0)	VCEO(sus)	80		Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	V(BR)CBO	120	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	7.0	_	Vdc
Collector Cutoff Current ($V_{CB} = 90 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 90 \text{ Vdc}$, $I_E = 0$, $T_A = 150^{\circ}\text{C}$)	ІСВО	a	.010 15	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO	_	.010	μAdc
ON CHARACTERISTICS				
DC Current Gain $(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$ $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, T_A = -55^{\circ}\text{C})$ $(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	hFE	20 35 20 40	120	-
Collector-Emitter Saturation Voltage(1) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$) ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$)	VCE(sat)		1.2 5.0	Vdc
Base-Emitter Saturation Voltage(1) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$) ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$)	V _{BE(sat)}	_	0.9 1.3	Vdc
SMALL-SIGNAL CHARACTERISTICS		A TANK 194	NACTOR OF	
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	fT	50		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	_	15	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)	Cibo	6 ET	85	pF
Input Impedance (I _C = 1.0 mAdc, V_{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V_{CB} = 10 Vdc, f = 1.0 kHz)	h _{ib}	20 4.0	30 8.0	Ohms
Voltage Feedback Ratio ($I_C = 1.0 \text{ mAdc}$, $V_{CB} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$) ($I_C = 5.0 \text{ mAdc}$, $V_{CB} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h _{rb}	- Dire	1.25 1.50	X 10-4
Small-Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz})$ $(I_C = 5.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	h _{fe}	30 45	100	_
Output Admittance (I _C = 1.0 mAdc, V_{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V_{CB} = 10 Vdc, f = 1.0 kHz)	hob		0.5 0.5	μmhos

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

2N720A

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Emitter Voltage	VCES	aby 30	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous Peak	Ic	200	mAdc
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	0.3	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD PD	1.0 6.67	Watts mW/°C
Total Device Dissipation (a T _C = 100°C Derate above 100°C	PD	0.5 6.67	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	1-65 to +175	em ∘c

2N834 2N835

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N2368 for graphs.

C	haracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CTERSTICS	OFF CHARA
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	VoeRfaus)	nAdc. Rgg < 10 ohmst	V(BR)CBO	40	tokeelle tetti	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	VCBO(sya) V(BR)(CBO	10 = 81 30A 10 = 21	V(BR)EBO	5.0	nerene um en Brenkdow	Vdc
Collector Cutoff Current (VCB = 20 Vdc, I_E = 0) (VCB = 20 Vdc, I_E = 0, T_A = 150°C	Dearlasty Dearlasty	g = 0) = 150°C1	CBO	Voltage (fg (VCB = 80)	0.5	μAdc
Collector Cutoff Current (VCE = 30 Vdc, VBE = 0)	ORBI		CES	v 0.3 = 38V	30-10-0 H	μAdc
ON CHARACTERISTICS			CAN OF L	M. Charles F.O.		
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc)	340	10°83 - = 2	r)toohFE = 1	25	Total Control	_
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)				V ,sbAm 081 on Vonage(1	0.25	Vdc ma-leason-Err
Base-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc)		lg = 6.0 mAdd)) (Thatello\	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS				TERISTICS-	HAL CHARAC	DIE-TTEME
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 15 Vdc, f =	100 MHz)	VCE + 10 Vdc, f = 20 MHs)	bAm ft = gl	350	playor a G —	MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 100 kH	z) 343	TyPol	C _{obo}	147907 007	4.0	pF pF pqn
Magnitude of Forward Current Trans (IC = 10 mAdc, VCE = 15 Vdc, f =		mon-Emitter	h _{fe}	3.5	= 30_ son	npor Impad
SWITCHING CHARACTERISTICS	diff	Vdc, f = 1.0 kHz)	dc, Vcg = 5.0	Am 0.7 = 58	enter sond	dse- aparlov
Charge-Storage Time Constant (Figur (I _C = 10 mAdc, I _{B1} = I _{B2} = 10 m _s		5.0 Vdc, 1 = 1.0 kHz)	ts and the	0.0 = 0.0	25	ns
Turn-On Time (Figure 1) (I _C = 10 mAdc, I _{B1} = 3.0 mAdc, I _E	32 = 1.0 mAdc	(x10.0.1 = 1.	ton 80	obAm 0.1 =	35	ns ns
Turn-Off Time (Figure 1) (IC = 10 mAdc, I _{B1} = 3.0 mAdc, I _E	32 = 1.0 mAdc)	toff	10 Jas. Ci	75 (05)W 66149	ns

⁽¹⁾ Pulse Test: Pulse Width ≤ 12 ms, Duty Cycle ≤ 2.0%.

INIAMINIONI NATINGS				
Rating	Symbol	2N869A	2N4453	Unit
Collector-Emitter Voltage	VCEO	18	18	Vdc
Collector-Emitter Voltage	VCES	2	5	Vdc
Collector-Base Voltage	VCBO	25	25	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	IC	200		mAdc
Total Device Dissipation (a TA = 25°C Derate above 25°C	P _D	360 2.06	400 2.29	mW/°C
Total Device Dissipation (a $T_C = 25^{\circ}C$ $TC = 100^{\circ}C$ Derate above 25°C	PD	1.2 0.686 6.86	2.0 1.03 11.3	Watts Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to	+ 200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	2N869A	2N4453	Unit
Thermal Resistance, Junction to Case	$R_{\theta}JC$	146	97.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	486	585	°C/W



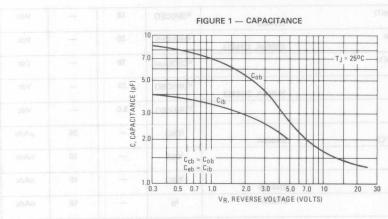
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	RITURNU CHARACTER				
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	2N4453	V(BR)CEO	18	_	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu Adc$, $V_{BE} = 0$)	2N869A, 2N4453	V(BR)CES	25	_	Vdc
Collector-Emitter Sustaining Voltage(1) (IC = 10 mAdc, IB = 0)		V _{CEO} (sus)	18	_	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_E = 0)$	2N869A, 2N4453	V(BR)CBO	25	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)		V(BR)EBO	5.0	_	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0, T _A = 150°C)	2N869A	ІСВО	_	25	μAdc
Collector Cutoff Current (V _{CE} = 15 Vdc, V _{BE} = 0)		ICES	_	10	nAdc
Emitter Cutoff Current (VEB = 4.5 Vdc, I _C = 0)	2N4453	IEBO	_	10	nAdc
Base Current (VCE = 15 Vdc, VBE = 0)	2N869A	lΒ	_	10	nAdc
ON CHARACTERISTICS(1)		14-7-19		10.	
DC Current Gain $(I_C = 10 \text{ mAdc}, V_{CE} = 0.3 \text{ Vdc})$ $(I_C = 10 \text{ mAdc}, V_{CF} = 5.0 \text{ Vdc})$	2N869A 2N869A	hFE	30 40	120	_
$(I_C = 30 \text{ mAdc}, V_{CE} = 0.5 \text{ Vdc})$	2N869A, 2N4453		40	120	
$(I_C = 30 \text{ mAdc}, V_{CE} = 0.5 \text{ Vdc}, T_A = -55^{\circ}\text{C})$ $(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N869A, 2N4453 2N869A, 2N4453		17 25	=	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 30 mAdc, I _B = 1.5 mAdc) (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	2N869A 2N4453 2N869A 2N869A, 2N4453	VCE(sat)		0.15 0.25 0.2 0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 30 mAdc, I _B = 1.5 mAdc) (I _C = 30 mAdc, I _B = 3.0 mAdc)	2N869A 2N4453 2N869A	VBE(sat)	0.78 0.8 0.85	0.98 1.1 1.2	Vdc
(I _C = 100 mAdc, I _B = 10 mAdc)	2N869A, 2N4453	1911		1.7	

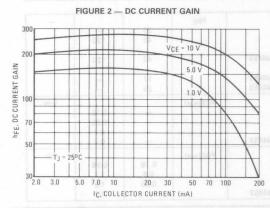
				- ,		INIMA	UIIIL
SMALL-SIGNAL CHARAC	CTERISTICS	18 Vds	81.			agalloV ret	nn. 3-ye/ballo
Current-Gain — Bandwid				asoft .	400	egetteV 102	MHz
$(I_C = 10 \text{ mAdc}, V_{CE} =$		-65V BC	26	Gany		Voltage	ezz. 6-sospello
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0), f = 140 kHz)	2N869A		Cobo	-	6.0	pF
Input Capacitance		SDAM USS		Cibo	8000	6.0	pF
$(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0.00 \text{ Vdc})$), f = 150 kHz)	2N869A	380	99	TA = 26°C		District Lines
Collector-Base Capacitan	ce	J With BX.S	QUA	Ccb		6.0	pF
$(V_{CB} = 5.0 \text{ Vdc}, I_{E} = 0)$), f = 1.0 MHz)	2N4453		69	and the same	a) noiseciae:	Japan Davice C
Emitter-Base Capacitance			8.36	Ceb	01001 = 31	6.0	vode pFased
$(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0.00)$), f = 1.0 MHz)	2N4453					and the same of th
SWITCHING CHARACTE	RISTICS	J 001 × 0	0.0	Bist of	111.112.01	ennsA s	
Turn-On Time	Lacs-CT) es-C v _{CC} =			ton	_	50	ns
Delay Time	$I_C = 30 \text{ mAdc},$ $I_{B1} = 1.5 \text{ mAdc}$	= 3.0 Vdc 2N4453 2N4453		t _d	1817108	35	ns
Rise Time	181 - 1.5 mAde	2N4453		lodnt _f 2	- 3	20	ns
Turn-Off Time	- 1	= 2.0 Vdc 2N869A		toff	on to Case	80	ns
Storage Time		= 3.0 Vdc 2N4453 2N4453		t _s	maldm A of ac	65	ns
Fall Time	1.5 IIIAGC	2114455		te		20	ne

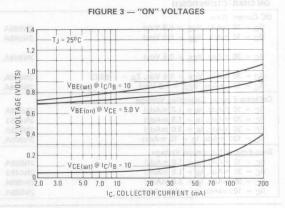
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle = 1.0%.

(2) f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

TYPICAL SWITCHING CHARACTERISTICS







MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 4 — CURRENT-GAIN — BANDWIDTH PRODUCT

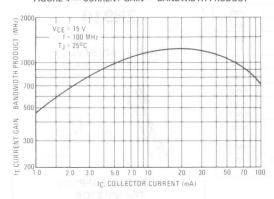


FIGURE 5 — TURN-ON TIME

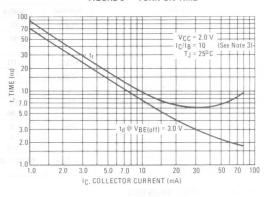


FIGURE 6 — TURN-OFF TIME

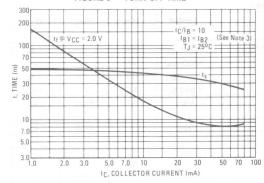


FIGURE 7 — SWITCHING TIME TEST CIRCUIT

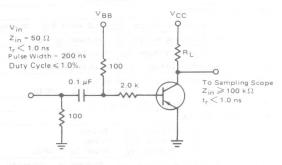


FIGURE 8 — SWITCHING TEST CIRCUIT VALUES

		V _{in} Volts	V _{BB} Volts	V _{CC} Volts	R _L Ohms	I _C	1 _{B1} (4) mA	1B2 (4)
ton, tr, td	2N869A	-7.0	3.0	2.0	62	30	1.5	-
	2N4453	-7.0	3.0	3.0	91	30	1.5	
toff, ts, tf	2N869A	+6.0	-4.0	2.0	62	30	1.5	1.5
	2N4453	+6.0	-4.0	3.0	91	30	1.5	1.5

(3) I_C/I_B = 10. Switching is shown to reflect current industry practices. Compare the values shown in Figures 1 and 2 @ I_C = 30 mA to the typical values in the Electrical Characteristics table @ I_C/I_B = 20.

 $^{(4) \}mid_{B1} = \mid_{B2} = 3.0 \text{ mA} \otimes \mid_{C} \mid_{B} = 10$

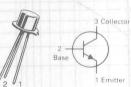
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	60	Vdc
Collector-Emitter Voltage (RBE = 10 Ohms)	VCER	80	Vdc
Collector-Base Voltage	VCBO	100	Vdc
Emitter-Base Voltage	VEBO	7.0	Vdc
Collector Current — Continuous	Ic	1.0	Amp
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.5 2.86	Watt mW/°C
Total Device Dissipation $@T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above 25°C	PD	1.8 1.0 10.3	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	97.4	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	350	°C/W

2N910

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

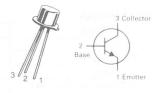
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	81 = g/\21		V 0 C = 30 V 5	
Collector-Emitter Breakdown Voltage (I _C = 100 mAdc, R _{BE} ≤ 10 ohms)(1)	VCER(sus)	80	11-5-1	Vdc
Collector-Emitter Sustaining Voltage (IC = 30 mAdc, IB = 0)(1)	VCEO(sus)	60		Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	V(BR)CBO	100		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	V(BR)EBO	7.0	-	Vdc
Collector Cutoff Current (V _{CB} = 75 Vdc, I _E = 0) (V _{CB} = 75 Vdc, I _E = 0, T _A = 150°C)	СВО		0.025 15	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO		0.025	μAdc
ON CHARACTERISTICS				
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc, T _A = -55°C)	hFE es (Am) TM3881	35 75 30		
Collector-Emitter Saturation Voltage $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$ $(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$	VCE(sat)	_	0.4 1.2	Vdc
Base-Emitter Saturation Voltage $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$ $(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$	V _{BE(sat)}	0.6	0.8 0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	fT	60		MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kHz)	C _{obo}	_	15	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)	Cibo	_	85	pF
Input Impedance (I _C = 5.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hie		1800	Ohms
Input Impedance (I _C = 1.0 mAdc, V_{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V_{CB} = 5.0 Vdc, f = 1.0 kHz)	tov hib	20 4.0	30 8.0	Ohms
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	hrb	b	3.0	X 10-4
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hfe	76	200	_
Output Admittance (I _C = 5.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	h _{oe}	20861	100	μmhos
Output Admittance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	hob e	219.6.6	0.5 1.0	μmho
Noise Figure ($I_C = 0.3 \text{ mAdc}$, $V_{CB} = 10 \text{ Vdc}$, $R_G = 510 \text{ ohms}$, $f = 1.0 \text{ kHz}$, $B W = 200 \text{ Hz}$)	NF	-	12	dB

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle = 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Emitter Voltage (R _{BE} ≤ 10 ohms)	VCER	20	Vdc
Collector-Base Voltage	VCBO	rict 40	- Vdc
Emitter-Base Voltage	VEBO	5.0	□ Vdc
Collector Current — Continuous(1)	IC	150	□ mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	360 2.06	mW/°C
Total Device Dissipation (α T _C = 25°C Derate above 25°C	PD	1.2 6.8	Watts mW/°C
Total Device Dissipation (a T _C = 100°C Derate above 100°C	PD	0.68	Watt
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

2N914

JAN, JTX AVAILABLE **CASE 22-03, STYLE 1** TO-18 (TO-206AA)



SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N2368 for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		conservation in		
Collector-Emitter Breakdown Voltage(2) (I _C = 30 mAdc, R _{BE} ≤ 10 ohms)	VCER(sus)	20	_	Vdc
Collector-Emitter Sustaining Voltage(2) (I _C = 30 mAdc, I _B = 0)	VCEO(sus)	15		Vdc
Collector-Base Breakdown Voltage ($I_C = 1.0 \mu Adc, I_E = 0$)	V(BR)CBO	40	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	-	Vdc
Collector Cutoff Current (V _{CE} = 20 Vdc, V _{BE} = 0.25 Vdc, T _A = 125°C)	ICEX		10	μAdc
Collector Cutoff Current $(V_{CB} = 20 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 20 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$	СВО	_	0.025 15	μAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	IEBO	-	0.1	μAdc
ON CHARACTERISTICS			2,7 11 11	9
DC Current Gain(2) (I _C = 10 mAdc, V_{CE} = 1.0 Vdc) (I _C = 10 mAdc, V_{CE} = 1.0 Vdc, T_{A} = -55° C) (I _C = 500 mAdc, V_{CE} = 5.0 Vdc)	hFE	30 12 10	120	_
Collector-Emitter Saturation Voltage(2) (IC = 200 mAdc, I _B = 20 mAdc) (IC = 10 mAdc, I _B = 1.0 thru 20 mAdc, T _A = -55 to +125°C)	VCE(sat)	_	0.70 0.25	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	V _{BE} (sat)	0.70	0.80	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (IC = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	f _T	300		MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo}	-	6.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	C _{ibo}	- 1	9.0	pF
SWITCHING CHARACTERISTICS	K7176			
Storage Time(3) ($I_C = I_{B1} = I_{B2} = 20 \text{ mAdc}$)	t _S	do T	20	ns
Turn-On Time(3) (I _C = 200 mAdc, I _{B1} = 40 mAdc, I _{B2} = 20 mAdc)	ton		40	ns
Turn-Off Time(3) (I _C = 200 mAdc, I _{B1} = 40 mAdc, I _{B2} = 20 mAdc)	toff		40	ns

- (1) Limited by Power Dissipation.
- (2) Pulse Test: Pulse Width = 300 μ s, Duty Cycle \leq 1.0%. (3) Measured on Sampling Scope: Pulse Width \geq 200 ns.

SN914

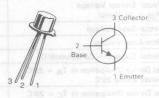
JAN, JTX AVAILABLE
CASE 22-03, STYLE 1
TO 18 (TO 2064A)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	50	0 d Vdc
Collector-Base Voltage	VCBO	sh4m 70	Vdc
Emitter-Base Voltage	VEBO	V/m 5.0	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.36 2.05	Watts mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.2 6.81	Watts mW/°C
Total Power Dissipation @ + 100°C Case	PD	0.68	W
Operating and Storage Temperature Temperature Range	TJ, T _{stg}	-65 to +200	or oc

2N915

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



GENERAL PURPOSE TRANSISTOR

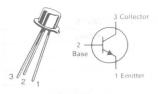
NPN SILICON

Refer to 2N3946 for graphs.

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	tournys		3172119736111	11.0	ALCOHOL: NO.	
Collector-Emitter Sustaining Voltage(1) (I _C = 10 mA I _B = 0)	(euer#30)¥	Adc, Rgg < 10 olyma)	VCEO(sus)	50 DagatioV awa	etter Breakdo	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ A I _E = 0)	Voeptsus) Voeptoeo	ids, (g = 0) (p = 0)	V _(BR) CBO	70	inter <u>Spribling</u> se Orgalidow	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA, I _C = 0)	O89(88)¥	(0, s	V(BR)EBO	5.0 HoV	Breakdown	Vdc
Collector Cutoff Current (V _{CB} = 60 V, I _E = 0)	080	Proper	СВО	(VCB = 20 V	0.010	μΑ
Collector Cutoff Current (VCB = 60 V, IE = 0) (VCB = 60 V, IE = 0, TA = +150°C)			Ісво	M 0.9 = 387	0.010	μΑ ASIAHO W
ON CHARACTERISTICS	and .				(S)m65	m vna9 i
DC Current Gain (IC = 10 mA VCE = 5.0 V)			hFE	50	200	10 = 01 10 = 01
Collector-Emitter Saturation Voltage (I _C = 10 mA I _B = 1.0 mA	Vestean		VCE(sat)	on Voltage(2)	1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mA I _B = 1.0 mA)		to = 125 C)	V _{BE} (sat)	Aum 08 -mards 0	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	trsalau*			(obArti 0	T w gl pbAc	nél = al
Output Capacitance (I _E = 0 V _{CB} = 10 V, f = 100 kHz)			C _{obo}	BOITERSTICE	3.5 AM	pF.H
Emitter Transition Capacitance (I _C = 0 V _{EB} = 0.5 V, f = 100 kHz)			C _{TE1} ou	10 Vin. f =	= 3010, hAn	o pF ₀
Input Impedance (I _C = 1.0 mA V _{CE} = 5.0 V) (I _C = 5.0 mA V _{CE} = 5.0 V)			h _{ie}	t = 1.0 MHz	6000 2000	ohms
High Frequency Current Gain $f = 100$ (I _C = 10 mA V _{CE} = 15 V)	MHz		hfe	2.5	STOARAND	DANASTW
Small-Signal Current Gain f = 1 kHz (IC = 1.0 mA VCE = 5.0 V)	a ₁		h _{fe}	40	200	18 = 3
(I _C = 5.0 mA V _{CE} = 5.0 V)	ng ²		share 20 sound	50	250	n/7 nO-n
Output Admittance (I _C = 1.0 mA V _{CE} = 5.0 V) (I _C = 5.0 mA V _{CE} = 5.0 V)			h _{oe}	gi ab A n 04	75 125	μmho: μmho
Collector Base Time Constant (IC = 10 mA, VCB = 10 V, f = 40 m	Hz)		rb'C _C	ation.	300	ps

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	25	Vdc
Collector-Base Voltage	VCBO	45	Vdc
Emitter-Base Voltage	VEBO	5	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.36 2.06	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 6.9	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

JAN AVAILABLE CASE 22-03, STYLE 1 TO-18 (TO-206AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3946 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			SAME OF IT	
Collector-Emitter Sustaining Voltage(1) (IC = 30 mA, IB = 0)	V _{CEO(sus)}	25		Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu A, I_E = 0)$	V(BR)CBO	45	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu A, I_C = 0$)	V(BR)EBO	5.0		Vdc
Collector Cutoff Current (V _{CB} = 30 V, I _E = 0)	СВО	_	10	nAdc
Collector Cutoff Current (a 150°C (V _{CB} = 30 V, I _E = 0)	ICBO	_	10	μAdc
ON CHARACTERISTICS				
DC Current Gain(1) (I _C = 10 mA, V_{CE} = 1.0 V) (I _C = 10 mA, V_{CE} = 1.0 V, -55°C)	hFE	50 15	200	_
Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA)	VCE(sat)	_	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA)	V _{BE} (sat)	174 17	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS		1 1/2 27 1		
Output Capacitance (V _{CB} = 5.0 V, I _E = 0)	C _{obo}	1 <u>,1-</u> 4 +113,	6.0	pF
Input Capacitance $(V_{EB} = 0.5 \text{ V, I}_{C} = 0)$	C _{ibo}	Jea s – o	10	pF
Input Impedance, $f = 1.0 \text{ kHz}$ (I _C = 1.0 mA, V _{CE} = 5.0 V) (I _C = 5.0 mA, V _{CE} = 5.0 V)	h _{ie}	gr (-	6000 2000	ohms ohms
Small-Signal Current Gain, $f=1.0 \text{ kHz}$ ($I_C=1.0 \text{ mA}, V_{CE}=5.0 \text{ V}$) ($I_C=5.0 \text{ mA}, V_{CE}=5.0 \text{ V}$)	hfe	40 50	200 250	_
Magnitude of Forward Circuit Transfer Ratio, Common-Emitter (I _C = 10 mA, V _{CE} = 15 V)	h _{fe}	3.0	1 4 5 T 1 70	_
Output Admittance, $f = 1.0 \text{ kHz}$ ($I_C = 1.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$) ($I_C = 5.0 \text{ mA}$, $V_{CE} = 5.0 \text{ V}$)	h _{oe}	=	75 125	μmho μmho
Collector Base Time Constant (I _C = 10 mA, V _{CB} = 10 V, f = 40 MHz)	rb'C _C		300	ps

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.0%.

2N916

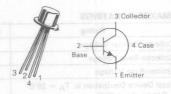
JAN AVAILABLE
CASE 22-03, STYLE
TO-18 (TO-286AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	3.0	Vdc
Collector Current — Continuous	lc -	50	mAdc
Total Device Dissipation $(a T_A = 25^{\circ}C)$ Derate above 25°C	PD	200 1.14	mW mW/°C
Total Device Dissipation (a $T_C = 25^{\circ}C$ Derate above 25°C	PD	300 1.71	mW mW/C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

2N918

JAN, JTX, JTXV AVAILABLE CASE 20-03, STYLE 10 TO-72 (TO-206AF)



AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Hati xsM niM Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CLEURLICS	AN.180 99
Collector-Emitter Sustaining Voltage (I _C = 3.0 mAdc, I _B = 0)	(aue)033 ^V ,	(0 = g) .A	VCEO(sus)	15 on Voltage	der <u>Su</u> stein a Breskdow	Vdc
Collector-Base Breakdown Voltage (I _C = 1.0 μAdc, I _E = 0)	V(BR)E8Q	(6)	V(BR)CBO	30 30	Brea lls fown	Vdc
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$			V(BR)EBO	3.0	tneymin for	Vdc
Collector Cutoff Current $(V_{CB} = 15 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 15 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$	950		ICBO	= (V 0	.010 1.0	μAdc μAdc
ON CHARACTERISTICS						
DC Current Gain (I _C = 3.0 mAdc, V _{CE} = 1.0 Vdc)			hFE	20	A, ig. 4 1.0	o () = ol
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	(ias)98 ^y		V _{CE} (sat)	адело (Ам	0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	odo9		V _{BE} (sat)	SOLISHIE	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					N. 18 31 .V	Ole 804
Current-Gain — Bandwidth Product(1) (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f =	100 MHz)		fT	600	(0 = 01 V	MHz
Output Capacitance (V _{CB} = 10 Vdc, I_E = 0, f = 140 kHz) (V _{CB} = 0, I_E = 0, f = 140 kHz)			C _{obo}		1.7 3.0	pF
Input Capacitance $(V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0, f = 140 \text{ kHz})$	g(i ⁽¹		Cibo	(V 0.	2.0	pF
Noise Figure (I _C = 1.0 mAdc, V _{CE} = 6.0 Vdc, R _G	= 400 Ohms, f = 60 M	Hz)	NF Commo	oladan tipa	6.0	dB
FUNCTIONAL TEST				- He n	E - 1 sonet	timb A turn
Amplifier Power Gain $(V_{CB} = 12 \text{ Vdc}, I_{C} = 6.0 \text{ mAdc}, f =$	200 MHz)		Gpe	15 (v o		
Power Output (V _{CB} = 15 Vdc, I _C = 8.0 mAdc, f =	500 MHz)		Po	30	ungO m riT s 41 = 80V /	
Collector Efficiency (V _{CB} = 15 Vdc, I _C = 8.0 mAdc, f =	500 MHz)		$\eta_{i,j} = \eta_{i,j}$ (i.e.			

⁽¹⁾ f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

2N930,A

JAN, JTX AVAILABLE CASE 22-03, STYLE 1 TO-18 (TO-206AA)





AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N2481 for graphs.

MAXIMUM RATINGS

Rating	Symbol	2N930	2N930A	Unit
Collector-Emitter Voltage	VCEO	45	60	Vdc
Collector-Base Voltage	VCBO	45	60	Vdc
Emitter-Base Voltage	VEBO	5.0	6.0	Vdc
Collector Current	lc	30 605		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	P _D		.5 .33	W mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 12		Watt mW/°C
Operating and Storage Temperature Temperature Range	TJ, T _{stg}	-65 to + 175		°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		6343	Coltania de la Coltan		
Collector-Emitter Breakdown Voltage (1) (I _C = 10 mAdc, I _B = 0)		V(BR)CEO	45	·	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V(BR)CBO	80	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	2N930 2N930A	V(BR)EBO	5.0 6.0	_	Vdc
Collector Cutoff Current (V _{CE} = 5.0 Vdc, I _B = 0)		ICEO	_	2.0	nAdc
Collector Cutoff Current (V _{CB} = 45 Vdc, I _E = 0)	2N930 2N930A	ICBO	_	10 2.0	nAdc
Collector Cutoff Current (V _{CE} = 45 Vdc, V _{BE} = 0)	2N930 2N930A	CES	_	10 2.0	nAdc
$(V_{CE} = 45 \text{ Vdc}, V_{BE} = 0, T_{A} = 170^{\circ}\text{C})$	2N930 2N930A		_	10 2.0	μAdc
Emitter Cutoff Current $(V_{BE} = 5.0 \text{ Vdc}, I_{C} = 0)$	2N930 2N930A	I _{EBO}	_	10 2.0	nAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 1.0 μ Adc, V _{CE} = 5.0 Vdc)	2N930A	hFE	60	_	-
$(I_C = 10 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$			100	300	
(I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, T _A = -55° C)	2N930 2N930A		20 30	_	
$(I_C = 500 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N930 2N930A		150	_	
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}) (1)$	2N930 2N930A		_	600 600	

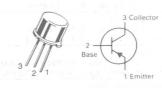
	nAdc, $IB = 0$.5 mAdc)		2N930 2N930				1.0 0.5	
	r Saturation N mAdc, $I_B = 0$					V _{BE(sat)}	0.7	0.9	Vdc
SMALL-SIG	NAL CHARAC	CTERISTICS						KATINGS	M JANIAAI
	n — Bandwid				26/330 2/093	odmyfT		goldski	MHz
$(I_C = 500)$	μAdc, V _{CE} =	= 5.0 Vdc, f	= 30 MHz)	2N93 2N93		VCEO	30 45	pagati s / tan	lin3-rotaet
Output Capa	acitance				20	C _{obo}	40	e Voltage	pF.
	.0 Vdc, $I_E = 0$	0, f = 1.0 M	Hz)	2N93		083,000	-	8.0 6.0	nual-ream Region Curr
nput Imped	lance			21433	3.0	d ⁹ h _{ib}	25 AT	32	ohms
	mAdc, V _{CB} =	= 5.0 Vdc, f	= 1.0 kHz)	3°Wm	3.33			25.0	onds stat
	dback Ratio mAdc, V _{CB} =	= 5.0 Vdc, f	= 1.0 kHz)			69 h _{rb}	TC = 25°C	600	X 10-6
Small-Signa	al Current Gai mAdc, V _{CE} =	n = 5.0 Vdc, f	= 1.0 kHz)	O* 8	- 65 to + 13	preT hfe	150	600	er <u>ati</u> ng and emperatur
Output Adm		- 50 Vdc f				h _{ob}	remarical	1.0	μmho
Noise Figur		- 5.0 vac, 1	leximy8	1.5910	n salwischo a	NF NF	HGUELORIA I	3.0	dB
$(I_C = 10)$	μAdc, V _{CE} =							CONTERNIT	F CHAILS
Car VV	k ohms, f = 1	70%	Duty Cycle ≤ 2.	09/		-	negsflov nw	obxeste tet	/h J-101381
/ ruise Tesi	i. Fuise widti	1 < 300 μs,	Duty Cycle < 2.	0 %.					
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Collector-Emitter Voltage (RBE ≤ 10 Ohms)	VCER	← 50 →		Vdc
Collector-Base Voltage	VCBO	50	60	Vdc
Emitter-Base Voltage	VEBO	← 5	.0 →	Vdc
Collector Current — Continuous	IC	← 600 →		mA
Total Device Dissipation $@T_A = 25^{\circ}C$ Derate above $25^{\circ}C$	PD	← 600 → ← 3.43 →		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	← 2.0 → ← 11.43 →		Watts mW/°C
Total Device Dissipation @ T _C = 100°C 2N1132A			.0	Watts
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 t	0 +200	°C

THERMAL CHARACTERISTICS

THE STATE OF THE S						
Characteristic	Symbol	Max	Unit			
Thermal Resistance, Junction to Case	$R_{\theta JC}$	87.49	°C/W			
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	291.55	°C/W			

JAN AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)



SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N2904 for graphs.

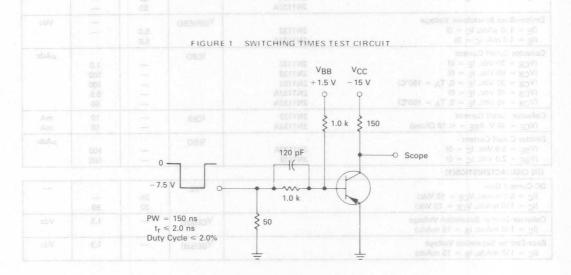
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Chara	cteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			STATE	PERSONAL PROPERTY.	470
Collector-Emitter Breakdown Voltage (I _C = 10 mA)	2N1132A 2N1132	V(BR)CEO	40 35	_	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)	2N1132 2N1132A	V(BR)CBO	50 60	ental seco	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$) ($I_E = 1.0 mA, I_C = 0$)	2N1132 2N1132A	V(BR)EBO	5.0 5.0	=	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 30 Vdc, I _E = 0, T _A = 150°C) (V _{CB} = 45 Vdc, I _E = 0) (V _{CB} = 45 Vdc, I _E = 0, T _A = 150°C)	2N1132 2N1132 2N1132 2N1132 2N1132A 2N1132A	ICBO	=	1.0 100 100 0.5 50	μAdc
Collector Cutoff Current (V _{CE} = 50 V, R _{BE} = ≤ 10 Ohms)	2N1132 2N1132A	CER	_	10 10	mA mA
Emitter Cutoff Current (VBE = 5.0 Vdc, I _C = 0) (VBE = 2.0 Vdc, I _C = 0)	2N1132A 2N1132	IEBO	=	100 100	μAdc
ON CHARACTERISTICS(1)					
DC Current Gain (I _C = 5.0 mAdc, V_{CE} = 10 Vdc) (I _C = 150 mAdc, V_{CE} = 10 Vdc)	***	hFE	25 30	90	_
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	4 8	VCE(sat)	1 AC <u>1</u>	1.5	Vdc
Base-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc)		V _{BE} (sat)	- Anner	1.3	Vdc

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS		330		Onms	(Figs = 10
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	90 88 Vdc	OBOVÍT	60	se Voltage	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	2N1132,	Cobo	auoun	45	pF pF
$(V_{CB} = 10 \text{ Vdc}, I_{E} = 0, f = 1.0 \text{ MHz})$	2N1132A	104	a TA- SEC	ms 30	
Input Capacitance $(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ kHz})$ $(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$	2N1132, 2N1132A	Cibo	0/20 — DT 0	80 80	PF PF PF PF PF PF PF PF PF PF PF PF PF P
Input Impedance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz (I _C = 5.0 mAdc, V _{CB} = 10 Vdc, f = 1.0 kHz		gq h _{ib}	ASC 25/15	35 10	Ohms
Voltage Feedback Ratio (IC = 5.0 mAdc, VCE = 5.0 Vdc, f = 1.0 kHz) (IC = 5.0 mAdc, VCE = 10 Vdc, f = 1.0 kHz)	3 103 - 67.68	h _{rb}	97112380	8.0 8.0	X 10-4
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	2N1132, 2N1132A	hfe	25 25 25	100 75	nemal Fa
$(I_C = 5.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N1132, 2N1132A	ALA ^R In	30 30	istance, June	r-R Jamen
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)		h _{ob}		1.0 5.0	μmhos
SWITCHING CHARACTERISTICS				CTERISTICS	AP AND FRO
Turn-On Time Os OHOLARIV	2N1132A	ton	egat leV rive	45	ns
Turn-Off Time	2N1132A	toff	_	35	ns

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.



2941893

MAXIMUM RATINGS

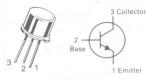
	0 1 1	37-1-1	08
Rating	Symbol	Value	Unit
Collector-Emitter Voltage (R _{BE} ≤ 10 Ohms)	VCER	50	Vdc
Collector-Base Voltage	VCBO	ab/ 75	Vdc
Emitter-Base Voltage	V _{EBO}	7.0	Vdc
Collector Current — Continuous	IC	500	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.8 4.57	Watt mW/°C
Total Device Dissipation (α T _C = 25°C Derate above 25°C	PD	3.0 17.15	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	58.3	°C/W

2N1613

JAN, JTX, JTXV AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 100 mAdc, R _{BE} ≤ 10 Ohms)	VCER(sus)	. 50	P.V. AND	-	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	V(BR)CBO	75			Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	7.0	(1871 <u>-1</u> 1.18)	1 I	Vdc
Collector Cutoff Current $(V_{CB} = 60 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 60 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$	ІСВО		epa <u>lle</u> e	10 10	nAdc μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)	IEBO	gl., <u>m</u> y 66	8.2	10	nAdc
ON CHARACTERISTICS(1)	10				
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc, T _A = -55° C) (I _C = 150 mAdc, V _{CE} = 10 Vdc) (I _C = 500 mAdc, V _{CE} = 10 Vdc)	hFE (clay) or the last of the	20 35 20 40 20	35 50 — 80 30	120 —	-
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	VCE(sat)	-	0.3	1.5	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	VBE(sat)	- 44	0.78	1.3	Vdc
SMALL-SIGNAL CHARACTERISTICS	N.O. 18 03/A	prijet git	g Fay	nitte 5	
Current-Gain — Bandwidth Product(1) (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	fT	60	m # 210a	ear III ji	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kHz)	Cobo	3 - 4 1 - 5	10	25	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 100 kHz)	Cibo	1 - <u> 1</u> - 5	50	80	pF
Input Impedance (I _C = 1.0 mAdc, V_{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V_{CB} = 10 Vdc, f = 1.0 kHz)	hib	24 4.0	V F. LEFT IS SANTED TO	34 8.0	Ohms
Voltage Feedback Ratio (IC = 1.0 mAdc, VCB = 5.0 Vdc, f = 1.0 kHz) (IC = 5.0 mAdc, VCB = 10 Vdc, f = 1.0 kHz)	hrb	5 4 0 1 3		3.0	X 10-4
Small-Signal Current Gain ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$) ($I_C = 5.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h _{fe}	30 35		100 150	_
Output Admittance ($I_{C} = 1.0 \text{ mAdc}$, $V_{CB} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$). ($I_{C} = 5.0 \text{ mAdc}$, $V_{CB} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h _{ob}	0.05 0.05	7 JL	0.5 0.5	μmhos
Noise Figure $(I_C = 0.3 \text{ mAdc, V}_{CE} = 10 \text{ Vdc, R}_S = 510 \text{ Ohms, f} = 1.0 \text{ kHz,}$ Bandwidth = 1.0 Hz)	NF	1 , 4 , 10	1 4 (===================================	12	dB
SWITCHING CHARACTERISTICS					1
Switching Time	$t_d + t_r + t_f$	_	_	30	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

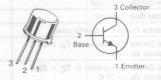
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	80	Vdc
Collector-Emitter Voltage	VCER	100	_{oa} Vdc
Collector-Base Voltage	Vсво	120	Vdc
Emitter-Base Voltage	VEBO	5bV 7.0	av Vdc
Collector Current — Continuous	lc	abV 0.5	0 7 Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.8 4.57	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	3.0 17.2	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	11.71°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	58.3	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	W 219	€ 8 °C/W

2N1893

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

NPN SILICON AND JAMESHI

Refer to 2N3019 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.), repris globally 2765 at ATT 22172/P372/APAHO 14 2017/3313

tinU water evi Characteristic danya	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			CTERNSTICS	FF CHARA
Collector-Emitter Breakdown Voltage (IC = 100 mAdc, RBE = 10 ohms)	VCER(sus)	100/	obsissed terri	Vdc
Collector-Emitter Sustaining Voltage(1) (I _C = 30 mAdc, I _B = 0)	VCEO(sus)	80 0	ewobs e erd s	- Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	V(BR)CBO	120	nwobs said	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	7.0ggV	Jnement Ho	Vdc
Collector Cutoff Current $(V_{CB} = 90 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 90 \text{ Vdc}, I_{E} = 0, T_{A} = 150^{\circ}\text{C})$	СВО	VCB 16 60 Vo	0.01	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO	_	0.01	μAdc
ON CHARACTERISTICS as and sand	(0 Vete)	10 politica Vot	He of mini	Corrent C
DC Current Gain(1) (I _C = 0.1 mAdc, V_{CE} = 10 Vdc) (I _C = 10 mAdc, V_{CE} = 10 Vdc) (I _C = 10 mAdc, V_{CE} = 10 Vdc, T_{A} = -55°C) (I _C = 150 mAdc, V_{CE} = 10 Vdc)	13 hFE 13 NO 13 13 15 15 15 15 15 15 15 15 15 15 15 15 15	20 35 20 40	# <u>3E</u>	-
Collector-Emitter Saturation Voltage ($I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc}$) ($I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc}$) ($I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc}$)	VCE(sat)	ottege (tg -	1.2 5.0	Vdc
Base-Emitter Saturation Voltage ($I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc}$) ($I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc}$)	V _{BE} (sat)	20172H31	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	(sHM 0		Ade Veg =	
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	or = fT0 = :	50	ggV) " -o netic	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $100 \text{ kHz} \le f \le 1.0 \text{ MHz}$)	Cobo	e 0.5 -V dc, lg	gg/15	pF pF
Input Capacitance (VBE = 0.5 Vdc, $I_C = 0$, 100 kHz $\leq f \leq$ 1.0 MHz)	Cibo	S mi Ad c, Ver	85	pF
Input Impedance (I _C = 1.0 mAdc, V_{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V_{CB} = 10 Vdc, f = 1.0 kHz)	hib = 8	20 4.0	30	Ohms one open
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V _{CB} = 10 Vdc, f = 1.0 kHz)	h _{rb}	lc = <u>8.0 mA</u> (lc = 1.0 p	1.25	X 10-4
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{fe}		100	mbA fugt
Output Admittance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V _{CB} = 10 Vdc, f = 1.0 kHz)	h _{ob}	5.0 <u>m</u> Ade. V Ade. V ce =	0.5	μmho

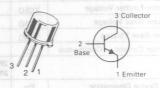
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	65	As Vdc
Collector-Emitter Voltage, R _{BE} ≤ 10 Ohms	VCER	80	Vdc
Collector-Base Voltage	VCBO	120	Vdc
Emitter-Base Voltage	VEBO	7.0	Vdc
Collector Current — Continuous (AAUS-OT)	et olc	1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.71	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	AG PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	175	°C/W

2N2102

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

FLECTRICAL	CHARACTERISTICS (TA -	25°C unless	otherwise n	(hator

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	Alleria C. Co.	A Co			
Collector-Emitter Breakdown Voltage (I _C = 100 mAdc, R _{BE} ≤ 10 ohms)	VCER(sus)	80	- 0	www.e52377.4	Vdc
Collector-Emitter Sustaining Voltage(2) (I _C = 100 mAdc, I _B = 0)	V _{CEO(sus)}	65	stoold mounts	Lancia Continu	Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{EB} = 1.5 Vdc)	V(BR)CEX	120	- (0	= g) aben	or Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	V(BR)CBO	120	_	- I	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	7.0	gstlaV hv	ese Breakdo	Vdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0, T _A = 150°C)	ІСВО	_	- 10	2.0 2.0	nAdc μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO		efigura u	2.0	nAdc
ON CHARACTERISTICS 0.8 SBREWS ASSESSED.					
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	R A-noV	20 35 20 40 25	0.6 — (Ho	120	0 rome 1 = 30 V 0 retter 50 V = 60 V
(I _C = 1.0 Adc, V _{CE} = 10 Vdc)(2)	Name	10	$C = \overline{A} = 1$	E al aby 0	- 83
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	VCE(sat)	30°05	0,15	= 9 0.5 V O	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	V _{BE} (sat)	-	0.88	mer1.1) No	□ Vdc
SMALL-SIGNAL CHARACTERISTICS	A-Sulfix.		10	= 21 ,abV 0.	E = 83,
Current-Gain — Bandwidth Product ($I_C = 50 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 20 \text{ MHz}$)	dhu2-A	60	0ε = m	BBV abV 0	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	Cobo		6.0	15	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)	Cibo	-	50	80	pF
Input Impedance (IC = 1.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz) (IC = 5.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h _{ib}	24 4.0		34 8.0	Ohm
Voltage Feedback Ratio ($I_C = 1.0$ mAdc, $V_{CE} = 5.0$ Vdc, $f = 1.0$ kHz) ($I_C = 5.0$ mAdc, $V_{CE} = 10$ Vdc, $f = 1.0$ kHz)	h _{rb}	_	= <u>10</u> Vdc	3.0	X 10
Small-Signal Current Gain (I _C = 1.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h _{fe}	30 35	(abV 0) =	100 150	0F = 10
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz) (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	doh 2N2218A	0.01 36 0.01 AT	= 1 0 .Vdc,	0.5 1.0	μmh
Noise Figure $(I_C = 300 \mu Adc, V_{CE} = 10 Vdc, R_S = 1.0 k Ohm, f = 1.0 kHz, Bandwidth = 1.0 Hz)$	NF	J-11	4.0	6.0	dB
SWITCHING CHARACTERISTICS	202279			3.3 - ,400-1111	,
Switching Time	$t_d + t_r + t_f$	-		30	ns

ZOIZNZ

MAXIMUM RATINGS

MAXIMOM NATINGS						
(QAROS-OT) 88		2N2218 2N2219 2N2221 2N2222	2N2218A 2N2219A 2N2221A 2N2222A	2N5581 2N5582	Unit	
Collector-Emitter Voltage	VCEO	30	40	40	Vdc	
Collector-Base Voltage	VCBO	60	75	75	Vdc	
Emitter-Base Voltage	VEBO	5.0	6.0	6.0	Vdc	
Collector Current — Continuous	Ic	800	800	800	mAdc	
unim3 T	1/2/1	2N2218,A 2N2219,A	2N2221,A 2N2222,A	2N5581 2N5582		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.8 4.57	0.5 2.28	0.6 3.33	Watt mW/°C	
Total Device Dissipation (a) T _C = 25°C Derate above 25°C	PD	3.0 17.1	1.2 6.85	2.0 11.43	Watts mW/°C	
Operating and Storage Junction Temperature Range	TJ, T _{stg}		- 65 to + 200			

2N2218,A/2N2219,A 2N2221,A/2N2222,A 2N5581/82

JAN, JTX, JTXV AVAILABLE

2N2218,A 2N2219,A CASE 79-02 TO-39 (TO-205AD) STYLE 1 2N2221,A 2N2222,A

STYLE 1 2N2221,A 2N2222,A CASE 22-03 TO-18 (TO-206AA) STYLE 1

2N5581 2N5582 CASE 26-03 TO-46 (TO-206AB) STYLE 1

GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit			
OFF CHARACTERISTICS	F CHARACTERISTICS			Programmes to restrict the second				
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IB = 0)	Non-A Suffix A-Suffix, 2N5581, 2N5582	V(BR)CEO	30 40	nor B <u>re</u> akdov Sre ak Joven	Vdc			
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	Non-A Suffix A-Suffix, 2N5581, 2N5582	V(BR)CBO	60 75	60 75				
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	Non-A Suffix A-Suffix, 2N5581, 2N5582		5.0 6.0	V) tostru0 (V BD-130997	Vdc			
Collector Cutoff Current (VCE = 60 Vdc, VEB(off) = 3.0 Vdc)	A-Suffix, 2N5581, 2N5582	ICEX	i mA de , Voi inAde, Voe	0 = 10 mis	nAdc			
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 150°C) (V _{CB} = 60 Vdc, I _E = 0, T _A = 150°C)	Non-A Suffix A-Suffix, 2N5581, 2N5582 Non-A Suffix A-Suffix, 2N5581, 2N5582	ICBO	made, Vgg 0 mAde, Vg 0 mAde, Vg 2 Ade, Vgg n Vollege	0.01 0.01 10 10				
Emitter Cutoff Current (VFB = 3.0 Vdc, IC = 0)	A-Suffix, 2N5581, 2N5582	IEBO	reportes		nAdc			
Base Cutoff Current (VCE = 60 Vdc, VEB(off) = 3.0 Vdc)	A-Suffix	BL -	Product ()	20	nAdc			
ON CHARACTERISTICS	1200	001 = 1.0 = 3	= 10 Velc 1	ent/l sanst	our Cape			
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 10 Vdc)	2N2218,A, 2N2221,A, 2N5581(1) 2N2219,A, 2N2222,A, 2N5582(1)	001 hFE,0 =		i = <u>bli</u> son	riosu sa puc sbequni suc			
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N2218,A, 2N2221,A, 2N5581 2N2219,A, 2N2222,A, 2N5582	de Veg = 5.0 de Veg = 10-		oack Re tto d	hage Feed			
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N2218,A, 2N2221,A, 2N5581(1) 2N2219,A, 2N2222,A, 2N5582(1)	nAdc, Vgg = 1 nAdc, Vgg =	35 75	Cucrem Gain				
(I _C = 10 mAdc, V _{CE} = 10 Vdc, T _A = +55°C)	2N2218A, 2N2221A, 2N5581 2N2219A, 2N2222A, 2N5582	0g = 5.6 Vda 0g = 10 Vda.	15 0.3 35	= 30-				
(I _C = 150 mAdc, V _{CE} = 10 Vdc)(1)	2N2218,A, 2N2221,A, 2N5581 2N2219,A, 2N2222,A, 2N5582	10 Vdc, Rg = = 1.0 Hz)	40 100	120 300	ENAR-DENA			

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Many Characteristic		Symbol	Min	Max	Unit
/I- 150 Ada W 1.0 VdaV1V	2N2218,A, 2N2221,A, 2N5581		20	CHARACTER	EMINOTIN
$(I_C = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})(1)$	2N2219,A, 2N2221,A, 2N5582	Valo, Visitionii) Ado, liga = 18	50		Smit van
	2142210,7, 2142222,7, 2140002	a tel topy	municipal district		amil se
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N2218, 2N2221		20	_	
en 82502 - ai	2N2219, 2N2222	Vdc, Ic = 150	30		mail equal
an 00 1	2N2218A, 2N2221A, 2N5581	- (obAm 6)	25	F	armi7 II
	2N2219A, 2N2222A, 2N5582	161	40		
Collector-Emitter Saturation Voltage(1)		VCE(sat)	37 Vite) (Sal	land James r	Vdc
$(I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$	Non-A Suffix	Or YT OURSES Y	BOY 1911 A 00	0.4	A12221A
	A-Suffix, 2N5581, 2N5582			0.3	A 21 22 1 13
(la - E00 mAda la - E0 mAda)	Non-A Suffix			1.6	
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$	A-Suffix, 2N5581, 2N5582			1.0	
B - F '44 C	A Guilla, 2140001, 2140002	1/		1.0	1/1-
Base-Emitter Saturation Voltage(1)	Non-A Suffix	VBE(sat)	0.6	1.3	Vac
(I _C = 150 mAdc, I _B = 15 mAdc)	A-Suffix, 2N5581, 2N5582	and the second	0.6	1.2	
			0.0	1.2	
(I _C = 500 mAdc, I _B = 50 mAdc)	Non-A Suffix	HOURE	_	2.6	
	A-Suffix, 2N5581, 2N5582			2.0	10.8
SMALL-SIGNAL CHARACTERISTICS					1 1 1 1
Current-Gain — Bandwidth Product(2)	1 1000	= T-fT			MU-
(I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	All Types, Except	the property of	250		IVITIZ
11C = 20 111/40, VCE = 20 Vd0, 1 100 11112/	2N2219A, 2N2222A, 2N5582		300		
Output Capacitance(3)		Cobo		8.0	nE
(V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)		CODO		8.0	pr
		0		(Sept. (Sept.)	Circle Interest
Input Capacitance(3) (V _{EB} = 0.5 Vdc, I _C = 0, f = 100 kHz)	Non-A Suffix	Cibo		30	pr.
(VEB - 0.5 vdc, IC - 0, 1 - 100 KHZ)	A-Suffix, 2N5581, 2N5582			25	1
Input Impedance	, t danix, 2,1000 i, 2,10002	h.			kahma
(I _C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N2218A, 2N2221A	hie	1.0	3.5	
(IC = 1.0 MAGE, VCE = 10 VGE, T = 1.0 KHZ)	2N2219A, 2N2222A		2.0	8.0	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A, 2N2221A	9.8	0.2	1.0	18 60
	2N2219A, 2N2222A		0.25	1.25	
Voltage Feedback Ratio		hre			X 10-4
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A, 2N2221A		_	5.0	
	2N2219A, 2N2222A		_	8.0	
// 10 A W 10 W 6 10 W	ONIGOROA ONIGORAA			0.5	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A, 2N2221A 2N2219A, 2N2222A	Maria de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de	The Tark	2.5 4.0	
	LIVEZ IJM, ZIVZZZZM		1	4.0	kohms
Small-Signal Current Gain	20122104 20122244	hfe	20	150	X 10-4
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A, 2N2221A 2N2219A, 2N2222A		30 50	150 300	
	TAMES OF SERVICE AND SERVICE	2 - 601160	3611013	300	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A, 2N2221A		50	300	
	2N2219A, 2N2222A		75	375	
Output Admittance no memo seed to traite a	This graph shows th	hoe		48	μmhos
(I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	2N2218A, 2N2221A	06	3.0	15	,
nd A. (forced gain) is the ratio of LeVI in a circuit.			5.0	35	10
= 1.0				VII	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N2218A, 2N2221A 2N2219A, 2N2222A		10	100	
			25	200	1 20
Collector Base Time Constant (I _E = 20 mAdc, V _{CB} = 20 Vdc, f = 31.8 MHz)		rb'C _c		150	ps
Noise Figure 1300 Visis mixtoriggs at flow 1 60 and tisk		NF	_	4.0	dB
$IIC = 100 \mu Adc. VCE = 10 Vdc.$					
R _S = 1.0 kohm, f = 1.0 kHz) with British adult	2N2222A				***************************************
Real Part of Common-Emitter	EATH SW	Re(hie)		60	Ohms
High Frequency Input Impedance		10			
$(I_C = 20 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 300 \text{ MHz})$	2N2218A, 2N2219A				-
	2N2221A, 2N2222A				11

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ ff is defined as the frequency at which |htel extrapolates to unity.
(3) 2N5581 and 2N5582 are Listed C_{cb} and C_{eb} for these conditions and values.

	OTHER ROTE OF THE PARTY OF THE	Symbol	IVIII	iviax	Unit	
SWITCHING CHARA	CTERISTICS					
Delay Time	(V _{CC} = 30 Vdc, V _{BE(off)} = 0.5 Vdc,	t _d	1.0 <u>Valci</u> (1)	10 hAr	ns Ol	
Rise Time	I _C = 150 mAdc, I _{B1} = 15 mAdc) (Figure 14)	t _r	_	25	ns	
Storage Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc,	ts	(ERODV U)	225	ns	
Fall Time —	I _{B1} = I _{B2} = 15 mAdc) (Figure15)	tf	_	60	ns	
Active Region Time (I _C = 150 mAdc, V 2N2221A, 2N2222A	CE = 30 Vdc) (See Figure 12 for 2N2218A, 2N2219A,	TA	The state of the s	tien 2.5 mm - 2.5 mm - Ado, 1g		



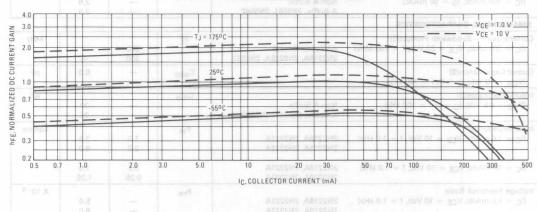
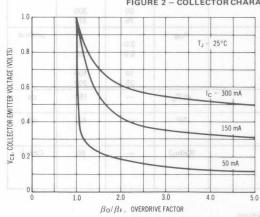


FIGURE 2 - COLLECTOR CHARACTERISTICS IN SATURATION REGION



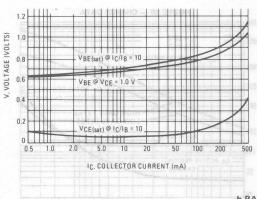
This graph shows the effect of base current on collector current. β_o (current gain at the edge of saturation) is the current gain of the transistor at 1 volt, and β_v (forced gain) is the ratio of I_c/I_B in a circuit.

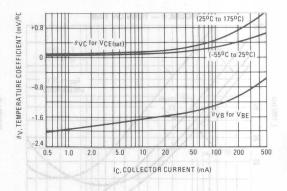
EXAMPLE: For type 2N2219, estimate a base current (l_{μ}) to insure saturation at a temperature of 25 °C and a collector current of 150 mA.

Observe that at I_c = 150 mA an overdrive factor of at least 2.5 is required to drive the transistor well into the saturation region. From Figure 1, it is seen that h_K @ 1 volt is approximately 0.62 of h_K @ 10 volts. Using the guaranteed minimum gain of 100 @ 150 mA and 10 V, $\beta_{\odot}=62$ and substituting values in the overdrive equation, we find:

$$\frac{\beta_o}{\beta_i} = \frac{h_{ii} @ 1.0 \text{ V}}{I_c/I_{ji}}$$
 $2.5 = \frac{62}{150/I_{ji}}$ $I_{ji} \approx 6.0 \text{ mA}$





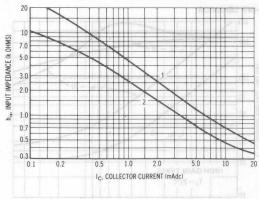


h PARAMETERS

This group of graphs illustrates the relationship between $h_{\mbox{\it fe}}$ and other "h" parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were selected and the same units were used to develop the correspondingly numbered curves on each graph.



FIGURE 6 — VOLTAGE FEEDBACK RATIO



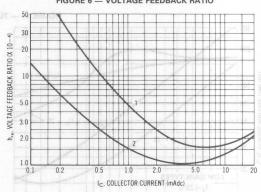
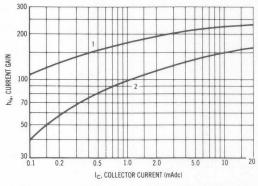


FIGURE 8 — OUTPUT ADMITTANCE

IC, COLLECTOR CURRENT (mAdc)

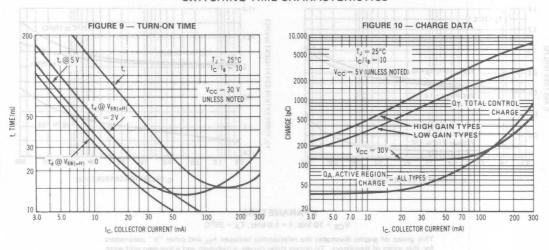
FIGURE 7 — CURRENT GAIN

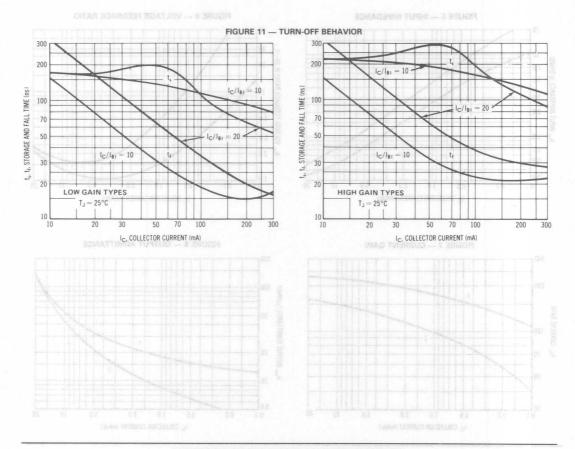
200 100 hoe. OUTPUT ADMITTANCE (1cmhos) 20 5.0 0.2 2.0



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

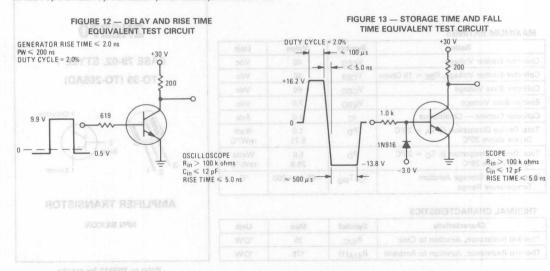






4

2N2218.A/2N2219.A/2N2221.A/2N2222.A/2N5581/82



Symbol		

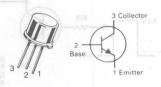
1 R_{f JA} is measured with the device soldered into a typical printed circuit board.
3 Pulse Tast: Pulse Width ≤ 300 µs. Duty Cycle ≤ 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Emitter Voltage, R _{BE} ≤ 10 Ohms	VCER	60	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	7.0	Vdc
Collector Current — Continuous	Ic	1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.71	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C 0

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	175	°C/W

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

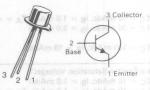
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 100 mAdc, R _{BE} ≤ 10 Ohms)	V(BR)CER	60	_	_	Vdc
Collector-Emitter Sustaining Voltage(2) (I _C = 100 mAdc, I _B = 0)	VCEO(sus)	45	_	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 0.05 \mu Adc, I_E = 0$)	V(BR)CBO	60	-	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	V(BR)EBO	7.0	_	_	Vdc
Collector Cutoff Current $(V_{CB} = 60 \text{ Vdc}, I_{E} = 0, T_{C} = 25^{\circ}\text{C})$ $(V_{CB} = 60 \text{ Vdc}, I_{E} = 0, T_{C} = 150^{\circ}\text{C})$	ICBO	=	=	0.05 100	μAdd
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO	-	_	100	nAdd
ON CHARACTERISTICS					
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 150 mAdc, V _{CE} = 10 Vdc)	hFE	30 50	90 135	200	_
Collector-Emitter Saturation Voltage ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$)	VCE(sat)	-	0.15	0.9	Vdc
Base-Emitter Saturation Voltage ($I_C = 150$ mAdc, $I_B = 15$ mAdc)	VBE(sat)	_	0.88	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product ($I_C = 50 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 20 \text{ MHz}$)	fT	100	250	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	-	10	15	pF
Input Capacitance $(V_{BE} = 0.5 \text{ Vdc, I}_{C} = 0, f = 100 \text{ kHz})$	C _{ibo}	_	60	80	pF
Small-Signal Current Gain ($I_C = 5.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$)	h _{fe}	50	-	275	-
Noise Figure ($I_C = 0.3 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $R_S = 1.0 \text{ k Ohm}$, $f = 1.0 \text{ kHz}$, $B.W. = 1.0 \text{ Hz}$)	NF	_	7.0	10	dB
SWITCHING CHARACTERISTICS			THE BOOK		
Total Switching Time	ton + toff	_	_	30	ns

⁽¹⁾ $R_{\theta,JA}$ is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%.

Collector-Emitter Voltage		VCES	40	Vdc
Collector-Base Voltage		VCBO	40	Vdc
Emitter-Base Voltage	2N2368,9,A 2N3227	V _{EBO}	4.5 6.0	Vdc
Collector Current (10 µs pulse)		IC(Peak)	500	mA
Collector Current — Conti	nuous 2N2369A, 2N3227	lC	200	ACMA MS
Total Device Dissipation (a: T _A = 25°C Derate above 25°C		PD	0.36 2.06	Watt mW/°C
Total Device Dissipation (a: T _C = 25°C Derate above 25°C	0V.0 08.0 2N3227	PD	1.2 6.85	Watts mW/°C
Total Device Dissipation (a: T _C = 100°C Derate above 100°C	80	PD	.68 6.85	Watts mW/°C
Operating and Storage Ju Temperature Range	nction	TJ, Tstg	-65 to +200	°C

2N3227

2N2369A JAN, JTX JTXV AVAILABLE CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

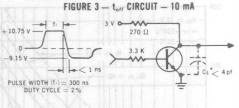
Characterist	Characteristic			Max	Unit
OFF CHARACTERISTICS	All Types		0, f = 140 kH	= 31 .abV 0.3	(/cs =)
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, V _{BE} = 0)	2N3227	V(BR)CEO	20 slob(= 140 k	citano .0 Vdc. fg =	egs Vdcin
Collector-Emitter Breakdown Voltage $(I_C = 10 \mu A, V_{BE} = 0)$		V(BR)CES	240 218	ETDAR A HD D	Vdc 8
Collector-Emitter Sustaining Voltage(1) (IC = 10 mAdc, IB = 0)	2N3227	VCEO(sus)	15	-	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu A, I_B = 0)$	2N2368	V(BR)CBO	40	abAm 01 = abAm 01 =	Vdc
Emitter-Base Breakdown Voltage $(I_E=10~\mu Adc,~I_E=0)$	2N2368, 2N2369, 2N2369A 2N3227	V(BR)EBO	4.5 6.0	Dr = 21 V 0	Vdc
Collector Cutoff Current (VCE = 20 Vdc, VBE = 3.0 Vdc)	2N3227	ICEX	and Art. O.E.	0.2	μAdc
Collector Cutoff Current (VCB = 20 Vdc, I _E = 0) (VCB = 20 Vdc, I _E = 0, T _A = 150°C)	2N2368, 2N2369 2N3227 2N2368, 2N2369, 2N2369A 2N3227	ICBO	3.0 mA, 193	0.4 0.2 30 50	μAdc
Collector Cutoff Current (VCE = 20 Vdc, VBE = 0)	2N2369A	ICES OF	mA, Vcc =	0.4	μAdc
Base Current (V _{CE} = 20 Vdc, V _{BE} = 0)	2N2369A	IB	л ≪ 300 дв, с	0.4	μAdc
ON CHARACTERISTICS					
DC Current Gain(1) (IC = 10 mAdc, V_{CE} = 1.0 Vdc)	2N2368 2N2369 2N2369A 2N3227	hFE	20 40 — 100	60 120 120 300	_
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^{\circ}C$	2N2368 2N2369 2N3227		10 20 40	Ē	
(I _C = 10 mAdc, V_{CE} = 0.35 Vdc, T_{A} = -55° (I _C = 30 mAdc, V_{CE} = 0.4 Vdc)	C) 2N2369A 2N2369A		20 30	_	

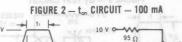
2M2368		Heit		Symbol			
ELECTRICAL CHARACTERIST	ICS (continued) (T	A = 25°C unle	ess otherwise note	ed.)		unities Voltage	i- etestici
A, COLLINA	Characteristic		18	Symbol	Min	Max	Unit
(Ic = 100 mAdc, VcF = 1.0 Vd	c)	2N2369A			20	_	
(IC 100 III las, TCE 1.10 Ta		2N3227		Sap _A	30	miter Voltag	
YTT, MAI, ARRES				Vego		lase Voitage	
$(I_C = 100 \text{ mAdc}, V_{CE} = 2.0 \text{ Vd})$	c)	2N2368 2N2369		VEBD	10	egarloV es	
	10.0	2112303	3.5	N A	T. GUILLENS		
Collector-Emitter Saturation Volta $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$		2N2368, 2N2	260 2012227	VCE(sat)	2013227	0.25	Vdc
(IC = 10 IIIAde, IB = 1.0 IIIAde		2N2369A	.505, 2145227	(A)(Pa(A)		0.00	
				1	2000000		
$(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$		2N2369A		21	Elinuo <u>lus</u> paradeka	0.30	
$(I_C = 30 \text{ mAdc}, I_B = 3.0 \text{ mAdc})$)	2N2369A			2N3227	0.25	
(I _C = 100 mAdc, I _B = 10 mAdd	c)	2N2369A		la ^q	_	0.50	
		2N3227	0.38	CI .	_	.45 0 39	
Base-Emitter Saturation Voltage(1	1) 1			V _{BE} (sat)		lovs 25°C	Vdc
$(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$		All Types		09	0.70		
	$(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}, T_A = +125^{\circ}\text{C})$ $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}, T_A = -55^{\circ}\text{C})$	2N2369A			0.59		
(IC = 10 mAdc, IB = 1.0 mAdc)		2N2369A 2N2369A			2143227	1.02	
TIC = 30 TIAGE, IB = 3.0 TIAGE	1	214230374		09		o Dissipation	
$(I_C = 100 \text{ mAdc}, I_B = 10 \text{ mAdd})$	c)	2N2369A			_	1.60	
		2N3227	8.85		0.8	1.4	(0 -910)7243
SMALL-SIGNAL CHARACTERIST	ICS						
Current-Gain — Bandwidth Produ	ıct			fT			MHz
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc},$, f = 100 MHz)	2N2368		(TA = 25°C del	400	ARAHU JAS	
		2N2369, 2N2	2369A, 2N3227	- I STORE THE TAX	500		
Output Capacitance	totaliyo			Cobo	-	4.0	pF
$(V_{CB} = 5.0 \text{ Vdc}, I_{E} = 0, f = 14)$		All Types		-			C a seminifica
Input Capacitance	VIBRICEO	2N3227		Cibo	lagette <u>V</u> riwo	4.0	pF
(V _{BE} = 1.0 Vdc, I _C = 0, f = 14		ZN3227			own Voltage	byles 18 rettim	i - otselfo
SWITCHING CHARACTERISTICS	A(BB)CES				aforms men	Company Ass	01
Delay Time (VCC	$= 10 \text{ V}, \text{V}_{\text{EB}} = 2.0$	0 Vdc,	2N3227	td		5.0	ns
Rise Time 100 m	$_{1}A, I_{B1} = 10 \text{ mA})$		2140227	tr	G C	18	ns
Storage Time				ts	egatloV m	vohúsatil eza	ns
$(I_C = I_{B1} = 10 \text{ mAdc}, I_{B2} = -1)$	-10 mAdc)		2N2368			10 A	
(I _C = 100 mAdc, I _{B1} = I _{B2} =		10 V)	2N2369A 2N3227		Voltage	13 wold 13 18 au	
- VGC	O83(88)Y	AGGESVIS	2143227		_	13	01 - 30
Fall Time $(V_{CC} = 10 \text{ V}, I_{C} = 100 \text{ mA}, I_{B})$	4 - Ino - 10 mΔ)		2N3227	tf		15	ns
Turn-On Time	XED		ZITOZZ,			12	O -urasilio
$(I_C = 10 \text{ mAdc}, I_{B1} = 3.0 \text{ mA},$	$l_{B2} = -1.5 \text{ mA.} V$	Vcc = 3.0 Vdc) All Types	ton	3.0 Vdc)	12 V O	ns
Turn-Off Time	0831	CC		1-44		menu9 Hou	ns
$(I_C = 10 \text{ mAdc}, I_{B1} = 3.0 \text{ mA},$	$l_{B2} = -1.5 \text{ mA}, V$	$V_{CC} = 3.0 \text{ Vdc}$	2N2368	toff	*	2 = 31 .abV 05	8113
2.0			2N2369,		-	-	
			2N2369A,		TA - TSO	15 18	- 83VI
			2N3227				
Total Control Charge (I _C = 10 mA, I _B = 1.0 mA, V _C	c = 30 V)		2N3227	Q _T	_	100 HOTU	o pC
	-	0.00/	LITOLLI		10	a agV obV 0	= 35V)
) Pulse Test: Pulse Width ≤ 300	μs, Duty Cycle ≤ 2	2.076.					

3 V 0-11

3.3 K

270 Ω





► < 1 ns

PULSE WIDTH (tı) = 300 ns $_{\star}$ DUTY CYCLE = 2%

FIGURE 1 - ton CIRCUIT - 10 mA

+10.6 V-

 $-1.5 \ \mathrm{V}$

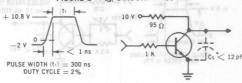
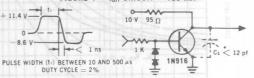


FIGURE 4 - toff CIRCUIT - 100 mA



*Total shunt capacitance of test jig and connectors.

FIGURE 5 — TURN-ON AND TURN-OFF TIME TEST CIRCUIT

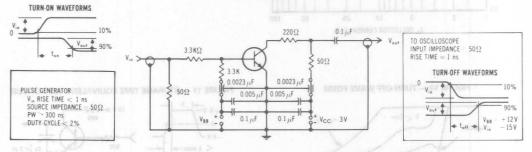


FIGURE 6 — JUNCTION CAPACITANCE VARIATIONS

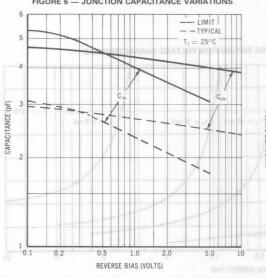
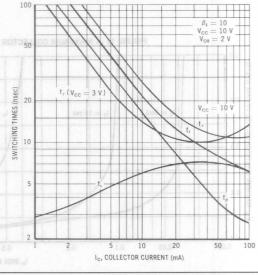
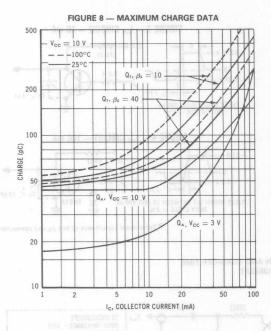
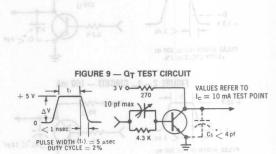


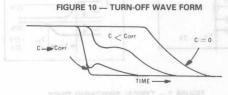
FIGURE 7 — TYPICAL SWITCHING TIMES

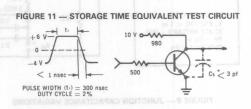


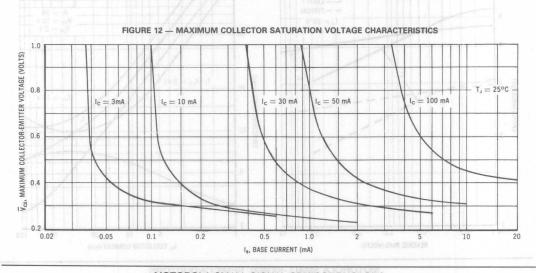
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

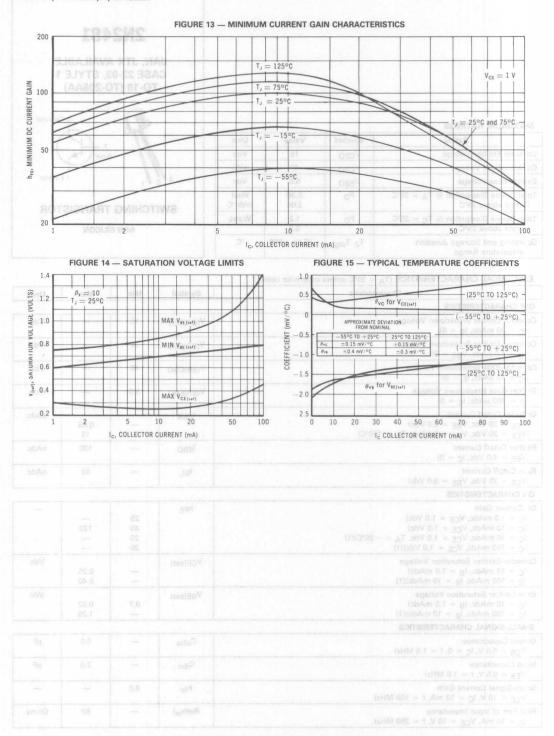












CASE 22-03, STYLE 1 TO-18 (TO-206AA)



JAN, JTX AVAILABLE

SWITCHING TRANSISTOR

NPN SILICON

MAXIMUM RATINGS Rating Symbol Value Unit 15 Vdc Collector-Emitter Voltage VCEO 40 Vdc Collector-Base Voltage **VCBO** Emitter-Base Voltage VEBO 5.0 Vdc 0.36 Watt Total Device Dissipation @ TA = 25°C PD Derate above 25°C 2.06 mW/°C 1.2 Watts Total Device Dissipation @ T_C = 25°C PD 6.9 Derate above 25°C °C Operating and Storage Junction -65 to +200 TJ, Tstg Temperature Range FIGURE 14 -- SATURATION VOLTAGE LIMITS

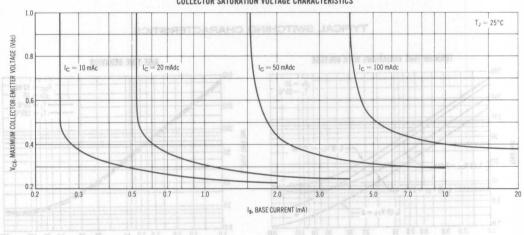
Characteristic Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				- 8
Collector-Emitter Breakdown Voltage (IC = 30 mAdc, I _B = 0)	V(BR)CEO	15		Vdc
Collector-Emitter Breakdown Voltage (IC = 1.0 μ Adc, V _{BE} = 0)	V(BR)CES	30	1	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V _(BR) CBO	40	IT	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	5.0		Vdc
Collector Cutoff Current (VCE = 20 Vdc, VBE = 3.0 Vdc) (VCE = 20 Vdc, VBE = 3.0 Vdc, TA = 150°C)	ICEX O	5 1 5 1 c, COL+ECTOR C	0.05 15	μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	IEBO	-	100	nAdc
Base Cutoff Current (V _{CE} = 20 Vdc, V _{BE} = 3.0 Vdc)	IBL		50	nAdc
ON CHARACTERISTICS				
DC Current Gain $ \begin{aligned} &(I_C = 1.0 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 10 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 10 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}, T_{A} = -55^{\circ}\text{C}) \\ &(I_C = 150 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ \end{aligned} $	hFE	25 40 20 20	120	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)(1)	VCE(sat)	Ξ	0.25 0.40	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)(1)	V _{BE} (sat)	0.7	0.82 1.25	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Output Capacitance ($V_{CB} = 5.0 \text{ V}, I_{C} = 0, f = 1.0 \text{ MHz}$)	C _{obo}	_	5.0	pF
Input Capacitance (VEB = 0.5 V, f = 1.0 MHz)	C _{ibo}	_	7.0	pF
Small-Signal Current Gain ($V_{CE} = 10 \text{ V}$, $I_{C} = 10 \text{ mA}$, $f = 100 \text{ MHz}$)	h _{fe}	3.0		-
Real Part of Input Impedance (I _C = 10 mA, V _{CF} = 10 V, f = 250 MHz)	Re(hie)	-	60	Ohm

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

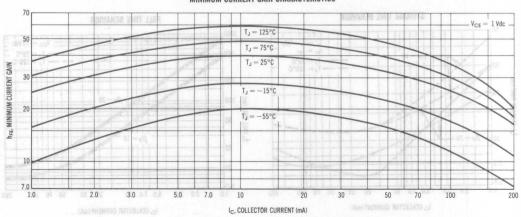
Characteristic	Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS			3*85 - 1	1
Storage Time (I _C = 10 mA, I _{B1} = 10 mA, I _{B2} = 10 mA)	t _S		20	ns
Turn-On Time (I _C = 100 mA, I _{B1} = 10 mA, V _{BE} (off) = 2.0 V) (I _C = 10 mA, I _{B1} = 1.0 mA, V _{BE} (off) = 2.0 V)	ton		40 75	ns
Turn-Off Time (IC = 100 mA, I _{B1} = 10 mA, I _{B2} = 5.0 mA) (IC = 10 mA, I _{B1} = 1.0 mA, I _{B2} = 0.5 mA)	toff		55 45	ns

⁽¹⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

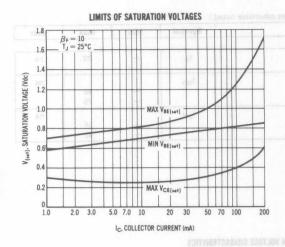
COLLECTOR SATURATION VOLTAGE CHARACTERISTICS

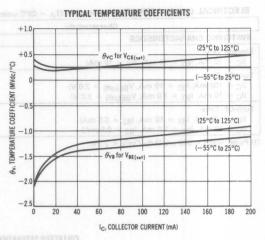


MINIMUM CURRENT GAIN CHARACTERISTICS

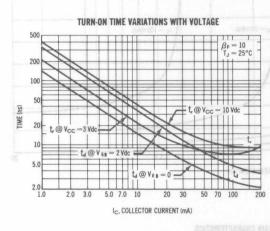


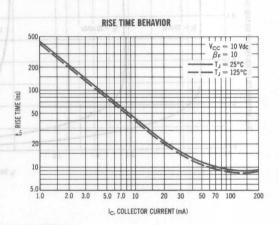
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

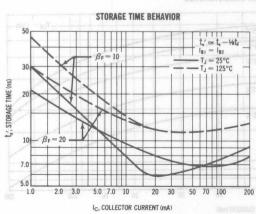


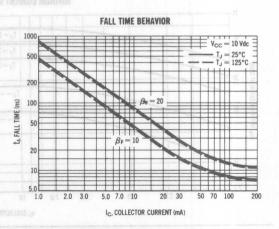


TYPICAL SWITCHING CHARACTERISTICS

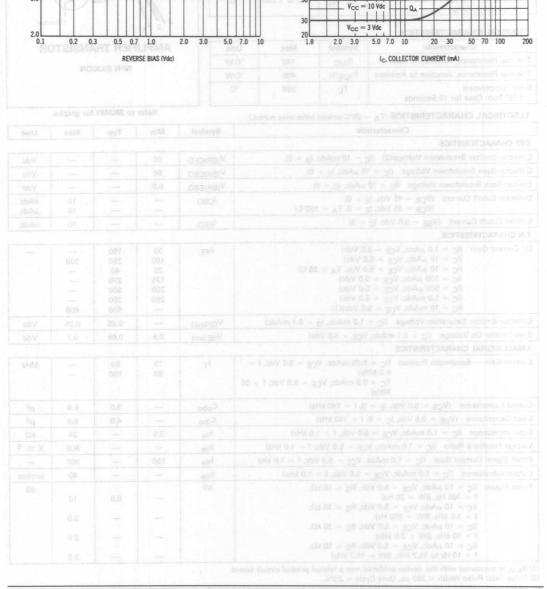












1000

500

100 70

50

Q, CHARGE (pC) 200

MAXIMUM - TYPICAL

7.0

3.0

CAPACITANCE (PF)

 $\beta_{F} = 10$ $T_{J} = 25^{\circ}C$

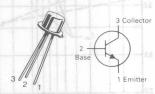
 $V_{\rm CC} = 10 \, \rm Vdc$

- T_J = 125°C

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	60	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	IC	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	360 2.06	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 6.85	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

2N2484

JAN, JTX, JTXV AVAILABLE CASE 22-03, STYLE 1 TO-18 (TO-206AA)



THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	146	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	485	°C/W
Lead Temperature 1/16" from Case for 10 Seconds	TL	300	°C

AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Refer	to 2	N2481	for gra	phs.
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Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	60		_	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	V(BR)CBO	60	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	6.0	-		Vdc
Collector Cutoff Current $(V_{CB} = 45 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 45 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$	ІСВО	_	_	10 10	nAdc μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, I _C = 0)	IEBO	-	-	10	nAdc
ON CHARACTERISTICS	1 284 765				
DC Current Gain (I _C = 1.0 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, T _A = 55°C) (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 500 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 5.0 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 1.0 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc) (I _C	hFE	30 100 20 175 200 250	190 250 40 275 300 350 400	500 — — — — — 800	
Collector-Emitter Saturation Voltage (I _C = 1.0 mAdc, I _B = 0.1 mAdc)	V _{CE} (sat)	_	0.25	0.35	Vdc
Base-Emitter On Voltage (I _C = 0.1 mAdc, V _{CE} = 5.0 Vdc)	V _{BE(on)}	0.5	0.65	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS			2.1		
Current-Gain — Bandwidth Product $(I_C = 0.05 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 5.0 \text{ MHz})$ $(I_C = 0.5 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 30 \text{ MHz})$	fΤ	15 60	50 100	=	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 140 kHz)	C _{obo}	_	3.0	6.0	pF
Input Capacitance ($V_{BE} = 0.5 \text{ Vdc}$, $I_{C} = 0$, $f = 140 \text{ kHz}$)	Cibo	_	4.0	6.0	pF
Input Impedance ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	hie	3.5	_	24	kΩ
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	h _{re}	-	_	800	X 10-
Small-Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz})$	h _{fe}	150	-	900	_
Output Admittance ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	hoe	-	-	40	μmho
Noise Figure $(I_C = 10 \ \mu Adc, V_{CE} = 5.0 \ Vdc, R_S = 10 \ k\Omega, f = 100 \ Hz, BW = 20 \ Hz)$ $(I_C = 10 \ \mu Adc, V_{CE} = 5.0 \ Vdc, R_S = 10 \ k\Omega,$	NF	-	8.0	10	dB
f = 1.0 kHz, BW = 200 Hz) (I _C = 10 μAdc, V _{CE} = 5.0 Vdc, R _S = 10 kΩ, f = 10 kHz, BW = 2.0 kHz)		_	_	3.0	
(IC = 10 μ Adc, VCE = 5.0 Vdc, RS = 10 k Ω , f = 10 Hz to 15.7 kHz, BW = 15.7 kHz)		_	_	3.0	

⁽¹⁾ R_{ØJA} is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%.

2N2501

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.36 2.1	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD PD	1.2 6.9	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

SWITCHING TRANSISTOR

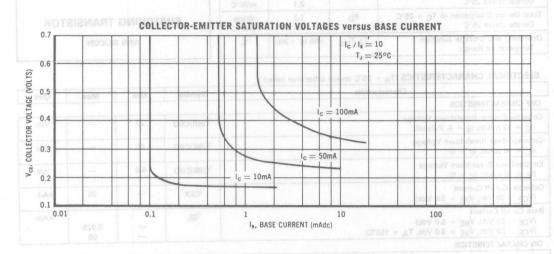
NPN SILICON

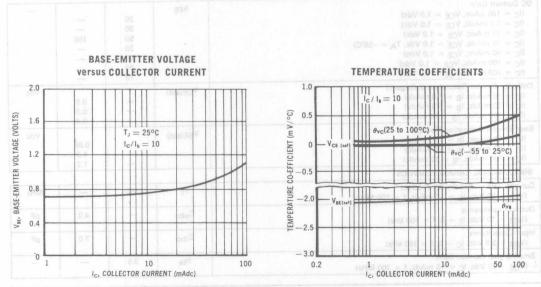
EL ECTRICAL	CHARACTERISTICS	ITA -	25°C unless	otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (IC = 30 mAdc, I _B = 0, Pulsed)	V(BR)CEO	20		Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	40	-	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V _{(BR)EBO}	6.0		Vdc
Collector Cutoff Current (VCE = 20 Vdc, VBE = 3.0 Vdc)	ICEX		25	nAdc
Base Cutoff Current (VCE = 20 Vdc, VBE = 3.0 Vdc) (VCE = 20 Vdc, VBE = 3.0 Vdc, TA = 150°C)	IBL	1:0	0.025 50	nAdc
ON CHARACTERISTICS				
DC Current Gain $ \begin{aligned} &(I_C = 100 \; \mu A dc, \; V_{CE} = 1.0 \; V dc) \\ &(I_C = 1.0 \; m A dc, \; V_{CE} = 1.0 \; V dc) \\ &(I_C = 10 \; m A dc, \; V_{CE} = 1.0 \; V dc) \\ &(I_C = 10 \; m A dc, \; V_{CE} = 1.0 \; V dc, \; T_{A} = -55^{\circ}C) \\ &(I_C = 50 \; m A dc, \; V_{CE} = 1.0 \; V dc) \\ &(I_C = 100 \; m A dc, \; V_{CE} = 1.0 \; V dc) \\ &(I_C = 500 \; m A dc, \; V_{CE} = 5.0 \; V dc) \end{aligned} $	BOATAOV THEREST	20 30 50 20 40 30	150 — 1848 —	_
Collector-Emitter Saturation Voltage(1) (IC = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	VCE(sat)		0.2 0.3 0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	VBE(sat)	res = .7 1 = .1 = 1 11 = 1	0.85 1.0 1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (V _{CE} = 20 Vdc, I _C = 10 mAdc, f = 100 MHz)	fT	350	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}		4.0	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 100 kHz)	C _{ibo}		7.0	pF
Small-Signal Current Gain $(V_{CF} = 20 \text{ Vdc}, I_C = 10 \text{ mAdc}, f = 100 \text{ MHz})$	h _{fe}	3.5	-	3 0

(3)	Same new record			
Characteristic	Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS				
Charge Storage Time Constant (I _C = I _{B1} = I _{B2} = 10 mAdc)	τS	-	15	ns
Total Control Charge (I _C = 10 mAdc, I _B = 1.0 mAdc)	Q_{τ}		60	pC
Active Region Time Constant (I _C = 10 mAdc)	тA	_	2.5	ns U MXAA

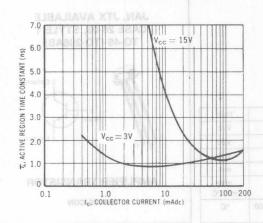
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.



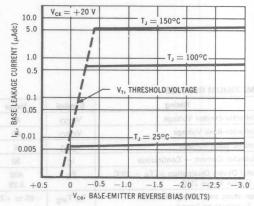


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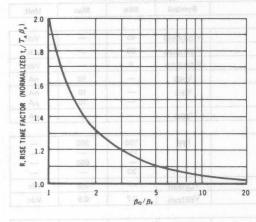
ACTIVE REGION TIME CONSTANT



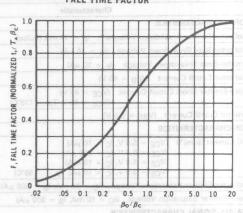
COMMON EMITTER DC LEAKAGE CHARACTERISTICS



RISE TIME FACTOR



FALL TIME FACTOR DARAMO JACISTOS ES



00 µA, (= 30 MHz)

cg = 5.0 V, ig = 1.0 mA, 1 = 1.0 kHz)

2N2605

JAN, JTX AVAILABLE CASE 26-03, STYLE 1 TO-46 (TO-206AB)





AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N3798 for graphs.

MAXIMUM RATINGS

IIIAXIIII CIII IIAIIII CO	The state of the s							
Rating	Symbol	Value	Unit					
Collector-Emitter Voltage	VCEO	45	Vdc					
Collector-Base Voltage	VCBO	60	Vdc					
Emitter-Base Voltage	VEBO	200.06	Vdc					
Collector Current — Continuous	IC	30	mA					
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	400 0 2.28	mW mW/°C					
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C					

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				100
Collector-Emitter Breakdown Voltage(1) I _C = 10 mA (Pulse)	V(BR)CEO	45	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μA)	V(BR)CBO	60		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μA)	V(BR)EBO	6		Vdc
Collector Cutoff Current (V _{CB} = 45 V)	ІСВО	1-	10	nA
Base-Emitter Short Circuit Current (V _{CE} = 45 V) (V _{CE} = 45 V, T _A = 170°C)	CES	-	10 10	nA μA
Emitter Cutoff Current (VBE = 5.0 V)	IEBO		2	nA
ON CHARACTERISTICS			2	_
DC Current Gain(1) $(V_{CE} = 5.0 \text{ V}, I_{C} = 10 \mu\text{A})$ $(V_{CE} = 5.0 \text{ V}, I_{C} = 500 \mu\text{A})$ $(V_{CE} = 5.0 \text{ V}, I_{C} = 10 \text{ mA})$ $(V_{CE} = 5.0 \text{ V}, I_{C} = 10 \mu\text{A}, T_{A} = -55^{\circ}\text{C})$	hFE	100 150 — 20	300 — 600 —	- ;I
Collector-Emitter Saturation Voltage ($I_C = 10$ mA, $I_B = 500 \mu$ A)	V _{CE} (sat)	and and	0.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 10$ mA, $I_B = 500 \mu$ A)	V _{BE} (sat)	0.7	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Output Capacitance (V _{CB} = 5.0 V, I _E = 0, f = 1.0 MHz)	Cobo	_	6	pF
Input Impedance (V _{CE} = 5.0 V, I _C = 1.0 mA, f = 100 MHz)	hie	_	200	Ω
Input Impedance ($V_{CB} = 5.0 \text{ V}$, $I_E = 1.0 \text{ mA}$, $f = 1.0 \text{ kHz}$)	hib	25	35	Ω
Voltage Feedback Ratio ($V_{CB} = 5.0 \text{ V}$, $I_E = 1.0 \text{ mA}$, $f = 1.0 \text{ kHz}$)	h _{rb}	-	10	10-4
Small-Signal Current Gain $(V_{CB}=5.0 \text{ V}, I_{E}=1.0 \text{ mA}, f=1.0 \text{ kHz})$ $(V_{CB}=5.0 \text{ V}, I_{C}=500 \mu\text{A}, f=30 \text{ MHz})$	hfe	150 1.0	600	
Output Admittance (V _{CB} = 5.0 V, I _E = 1.0 mA, f = 1.0 kHz)	hob	-	1	μmho
Noise Figure(2) ($V_{CB} = 5.0 \text{ V}$, $I_{C} = 10 \mu A$, $R_{q} = 10 \text{ k} \Omega$, $BW = 15.7 \text{ kHz}$)	NF	_	3	dB

⁽¹⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ Measured in amplifier with response down 3 dB at 10 Hz.

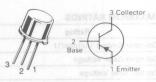
2N2894 CASE 22-03, STYLE TO-18 (TO-205AA)

MAXIMUM RATINGS

Rating	Symbol	Value w	Unit
Collector-Emitter Voltage	VCEO	56V 35	Vdc
Collector-Base Voltage	Vсво	obV 50	Vdc
Emitter-Base Voltage	VEBO	5.0 S	Vdc
Collector Current — Continuous	Ic	800	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.8 4.57	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	3.0 17.14	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	01 88°C

2N2800

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N2904 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) If to assign DHS = ATI SOTTEMENTO ARABO JACKSTON HE

that cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I _C = 100 mAdc, I _B = 0)	V/8R)CES	de Vgg = 0) Ade la = 0)	VCEO(sus)	00	nider Breakt mider Sustai	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	V(BR)CBC		V(BR)CBO	50	obile s ido	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	oaol leannan	TA = 125(C)	V(BR)EBO	5.0	Hott Coreen	Vdc
Collector Cutoff Current (V _{CE} = 25 Vdc, V _{BE} = 0.5 Vdc Off)	890		ICEX	(V _{CE} = 60 30 Vdc, VBE	100	nAdc
Base Cutoff Current (VCE = 25 Vdc, VBE = 0.5 Vdc Off)			IBL	_	100	nAdc
ON CHARACTERISTICS	240			(abl/ 6.9 =	any abAm	01 = 00
DC Current Gain (IC = 0.1 mAdc, V _{CE} = 10 Vdc) (IC = 150 mAdc, V _{CE} = 10 Vdc)(1) (IC = 150 mAdc, V _{CE} = 1.0 Vdc)(1) (IC = 500 mAdc, V _{CE} = 10 Vdc)(1)	VOE(sau)		hFE 6	20 30 15 25		10 = 30 10 = 10 checom 2
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	(the)1981V		VCE(sat)	3.0 mAde) 10 mAde) Voltage(2)	0.4 1.2	OT VGC
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)			VBE(sat)	1:0 mAde) 3:0 mAde) 10 mAde)	1.3 1.8	Vdc
SMALL-SIGNAL CHARACTERISTICS				EDITERBETICS	INFA CHAR	WE-LLAN
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 1	00 MHz)		(shot out	120	n — <u>Bandwi</u> mAde, V <u>cE</u>	MHz
Output Capacitance (V _{CB} = 10 Vdc, f = 100 kHz)	ado ⁰		Cobo	0, f = 140 k	25	pF
SWITCHING CHARACTERISTICS	Otto		The state of		eomális	SCHOOL CROSS
Delay Time			td	9	25	ns
Rise Time			t _r	25	45	ns
Storage Time	ho	(abAm 8.) = ea	t _s	100	225	ns
Fall Time	No.		tf	30	45	ns

Rating	Symbol	Value	Unit
Collector-Emitter Voltage(1)	VCEO	obV 12	Vdc
Collector-Base Voltage	VCBO	abV 12	Vdc
Emitter-Base Voltage	VEBO	abV 4.0	Vdc
Collector Current — Continuous	lc	DAm 200	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	000	mW mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1200 6.85	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	o1 99.€C 8

2N2894

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N869A for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and pasting of the ATI PORTERISTICA PARTOLINARY LIBERTY AND LIACING TO THE PROPERTY OF THE PROP

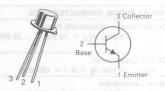
Held Kehl Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			A CTEMISTICS	OFF CHAS
Collector-Emitter Breakdown Voltage (I _C = 10 μAdc, V _{BE} = 0)	V(BR)CES	rgsilc12 nwol	nitte r B redikt	Vdc
Collector-Emitter Sustaining Voltage(2) (I _C = 10 mAdc, I _B = 0)	VCEO(sus)	12	e gli <u>ol</u> Am i	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	12	ess B <u>ra</u> akslov	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)	V(BR)EBO	4.0	B1 22 27 21	Vdc
Collector Cutoff Current (V _{CB} = 6.0 Vdc, I _E = 0, T _A = 125°C)	СВО	(0)	10	μAdc
Collector Cutoff Current (VCE = 6.0 Vdc, VBE = 0)	ICES	_	80	nAdc
Base Current (V _{CE} = 6.0 Vdc, V _{BE} = 0)	IB	0.5 Vdc 01	80	nAdc
ON CHARACTERISTICS — July 1997			Current	horu3 seel
DC Current Gain(2) (I _C = 10 mAdc, V _{CE} = 0.3 Vdc) (I _C = 30 mAdc, V _{CE} = 0.5 Vdc) (I _C = 30 mAdc, V _{CE} = 0.5 Vdc, T _A = -55°C)	hFE	30 40 17	ggV JbAm	ON CHAR 0C Currs or (1C = 0.7
(I _C = 100 mAdc, V _{CE} = 1.0 Vdc)(2) Collector-Emitter Saturation Voltage(2) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	VCE(sat)	RobV 0.1 = RobV 0.1 = RobV 0.1 = RobV 0.1 = RobV 0.1 =	0.15 0.2 0.5	Vdc
Base-Emitter Saturation Voltage(2) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	VBE(sat)	0.85	0.98 1.2 1.7	11. 13. see 6 (10. = 15)
SMALL-SIGNAL CHARACTERISTICS			NAL CHARA	-
Current-Gain — Bandwidth Product (I _C = 30 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	f _T	150 400 mb	n — B andwi m Ago, Vys	MHz
Output Capacitance (VCB = 5.0 Vdc, I _E = 0, f = 140 kHz)	C _{obo}	(sH) do	6.0 ₃₁₀₀	eo rpFuc
Input Capacitance $(V_{BE} = -0.5 \text{ Vdc}, I_{C} = 0, f = 140 \text{ kHz})$	C _{ibo}	a or rana.	6.0	ано р Буз
SWITCHING CHARACTERISTICS				7000
Turn-On Time ($V_{CC} = 2.0 \text{ Vdc}$, $V_{BE} = 3.0 \text{ Vdc}$, $I_{C} = 30 \text{ mAdc}$, $I_{B1} = 1.5 \text{ mAdc}$)	ton	-	60	ns nagaroti
Turn-Off Time $(V_{CC} = 2.0 \text{ Vdc}, I_C = 30 \text{ mAdc}, I_{B1} = I_{B2} = 1.5 \text{ mAdc})$	toff	h < 300 µs,	90 bill se Wid	ns ns

⁽¹⁾ Applicable from 0.01 to 10 mAdc. (2) Pulse Test: Pulse Width = 300 μ s, Duty Cycle \leq 2.0%.

MAXIMUM RATINGS					
Shy Rating	Symbol	2N2895	2N2896	2N2897	Unit
Collector-Emitter Voltage	VCEO	65	90	45	Vdc
Collector-Emitter Voltage	VCER	80	140	60	Vdc
Collector-Base Voltage	VCBO	120	140	60	Vdc
Emitter-Base Voltage	VEBO		7.0	2085/45	Vdc
Collector Current — Continuous	Ic		1.0	2N2897	Adc
Total Device Dissipation @ T _A = 25°C	PDdd		0.5		Watt
Derate above 25°C	odi		2.86		mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		1.8 10.3		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-	-65 to +2	00	°C

2N2896 2N2897

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL	CHARACTERISTICS	$(T_{\Delta} =$	25°C unless	otherwise noted.	.)
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Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 100 mAdc, R _{BE} = 10 ohms)	2N2895 2N2896 2N2897	V(BR)CES	80 140 60	Ξ	Vdc
Collector-Emitter Sustaining Voltage(1) $(I_C = 100 \text{ mAdc}, I_B = 0)$	2N2895 2N2896 2N2897	VCEO(sus)	65 90 45	Ξ	Vdc
Collector-Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}, I_E = 0$)	2N2895 2N2896 2N2897	V(BR)CBO	120 140 60	Ē	Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)		V _{(BR)EBO}	7.0		Vdc
Collector Cutoff Current $(V_{CB} = 60 \text{ Vdc}, I_{C} = 0)$	2N2895 2N2896 2N2897	СВО	Ē	0.002 0.01 0.05	μAdc
$(V_{CB} = 60 \text{ Vdc}, I_{E} = 0, T_{A} = +150^{\circ}\text{C})$	2N2895 2N2897		=	2.0 50	
$(V_{CB} = 90 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 90 \text{ Vdc}, I_{E} = 0, T_{A} = +150^{\circ}\text{C})$	2N2896 2N2896		_	0.01 10	
Emitter Cutoff Current $(V_{BE} = 5.0 \text{ Vdc}, I_{C} = 0)$	2N2895 2N2896 2N2897	IEBO		0.005 0.01 0.05	μAdc
ON CHARACTERISTICS					
DC Current Gain $ \begin{aligned} &(I_{\text{C}} = 10 \; \mu\text{Adc, V}_{\text{CE}} = 10 \; \text{Vdc}) \\ &(I_{\text{C}} = 100 \; \mu\text{Adc, V}_{\text{CE}} = 10 \; \text{Vdc}) \\ &(I_{\text{C}} = 1.0 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{Vdc}) \\ &(I_{\text{C}} = 1.0 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{Vdc}) \\ &(I_{\text{C}} = 10 \; \text{mAdc, V}_{\text{CE}} = 10 \; \text{Vdc, T}_{\text{A}} = -55^{\circ}\text{C}) \end{aligned} $	2N2895 2N2895 2N2896, 2N2897 2N2895 2N2895, 2N2896	hFE	10 20 35 35 20	= = = = = = = = = = = = = = = = = = = =	_
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N2895 2N2896 2N2897		40 60 50	120 200 200	
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N2895		25	_	

2N2895, 2N2896, 2N2897

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit		
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)				=	0.6	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	Vinit	2N2895, 2N2896 2N2897	V _{BE} (sat)	Ξ	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS	Othe	20 101	1 14 14 14		Separate Separate	G observed
Current-Gain — Bandwidth Product (IC = 50 mAdc, VCE = 10 Vdc, f = 20 MHz)	obiV Acid	2N2895, 2N2896 2N2897	f _T	120 100	Voltage	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	navv	2.0	C _{obo}	-	15	pF.
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)	37 Wes	2.68	Cibo	-	80	pF pF
Small-Signal Current Gain ($I_C = 5.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz}$)		2N2895 2N2896, 2N2897	hfe	50 50	200 275	Depart ab
Noise Figure		2112030, 2112037	NF	50	40 MM	
$(I_C = 0.3 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, R_S = 500 \text{ ohms}, f = 1.0 \text{ kHz}, BW = 15 \text{ kHz})$		2N2895	117A = 28°C U	orr <u>ei</u> nst	8.0	DER TOTAL

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.8%.

Rating	Symbol	Non-A Suffix A		A-Suffix	Unit	
Collector-Emitter Voltage	VCEO			60	Vdc	
Collector-Base Voltage	VCBO	60		Vdc		
Emitter-Base Voltage	VEBO	5.0			Vdc	
Collector Current — Continuous	IC		600			
Rg 0.8				2N3485,A 2N3486,A		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	600 3.43	400 2.28	400 2.28	mW mW/°C	
Total Davis a Dissipation	PD	3.43	2.20	2.20	IIIVV/ C	
@ T _C = 25°C Derate above 25°C	-,0	3.0 17.2	1.8 10.3	2.0 11.43	Watts mW/°C	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	n [†]	-65 to +2	00	°C	

2N2904,A, 2N2905,A, 2N2906,A, 2N2907,A, 2N3485,A, 2N3486,A

JAN, JTX, JTXV AVAILABLE*



GENERAL PURPOSE TRANSISTOR
PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

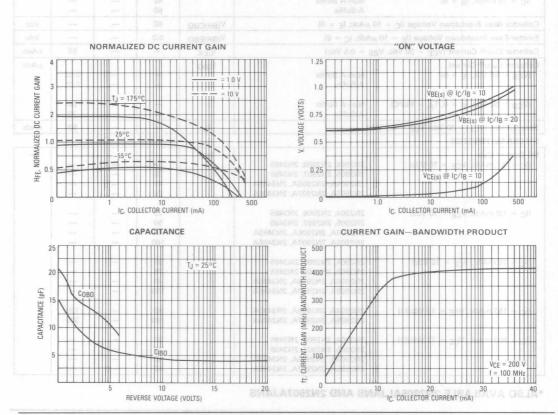
Characteri	Symbol	Min, 00	Тур	Max	Unit	
OFF CHARACTERISTICS	white on a	nfo extrapolate	ny at which i	neupert a	r sa benire	e rit
Collector-Emitter Breakdown Voltage(1) $(I_C = 10 \text{ mAdc}, I_B = 0)$	Non-A Suffix A-Suffix	V(BR)CEO	40 60	=	_	Vdc
Collector-Base Breakdown Voltage (I _C = 10	V(BR)CBO	60	_	-	Vdc	
Emitter-Base Breakdown Voltage (IE = 10)	V(BR)EBO	5.0	_	_	Vdc	
Collector Cutoff Current (VCE = 30 Vdc, VE	BE = 0.5 Vdc)	ICEX	HANG DO OF	ISUAMRO	50	nAdd
Collector Cutoff Current (VCB = 50 Vdc, I _E = 0)	Non-A Suffix A-Suffix	СВО		E	0.02 0.01	μAdd
$(V_{CB} = 50 \text{ Vdc}, I_{E} = 0, T_{A} = 150^{\circ}\text{C})$	Non-A Suffix A-Suffix				20 10	COMMEN
Base Current (VCE = 30 Vdc, VBE = 0.5 Vd	IB			50	nAdd	
ON CHARACTERISTICS	00 9 1111	TVIIII-W				in E
DC Current Gain (IC = 0.1 mAdc, VCE = 10 Vdc)	2N2904, 2N2906, 2N3485 2N2905, 2N2907, 2N3486 2N2904A, 2N2906A, 2N3485A 2N2905A, 2N2907A, 2N3486A	hFE	20 35 40 75			146 0
(I _C = 1.0 mAdc, V _{CE} = 10 Vdc) TOUGORY HTGWGMAS—MAD T	2N2904, 2N2906, 2N3485 2N2905, 2N2907, 2N3486 2N2904A, 2N2906A, 2N3485A 2N2905A, 2N2907A, 2N3486A	(Arti R	25 50 40 100	100 SL 100 E	E Direction	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N2904, 2N2906, 2N3485 2N2905, 2N2907, 2N3486 2N2904A, 2N2906A, 2N3485A 2N2905A, 2N2907A, 2N3486A	399x = u	35 75 40 100		0800	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N2904A, 2N2906A, 2N3485A 2N2905A, 2N2907A, 2N3486A		40 100		120 300	SPANAGA
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N2904, 2N2906, 2N3485 2N2905, 2N2907, 2N3486 2N2904A, 2N2906A, 2N3485A 2N2905A, 2N2907A, 2N3486A		20 30 40 50			8

*ALSO AVAILABLE 2N2905ALJANS AND 2N2907AJANS

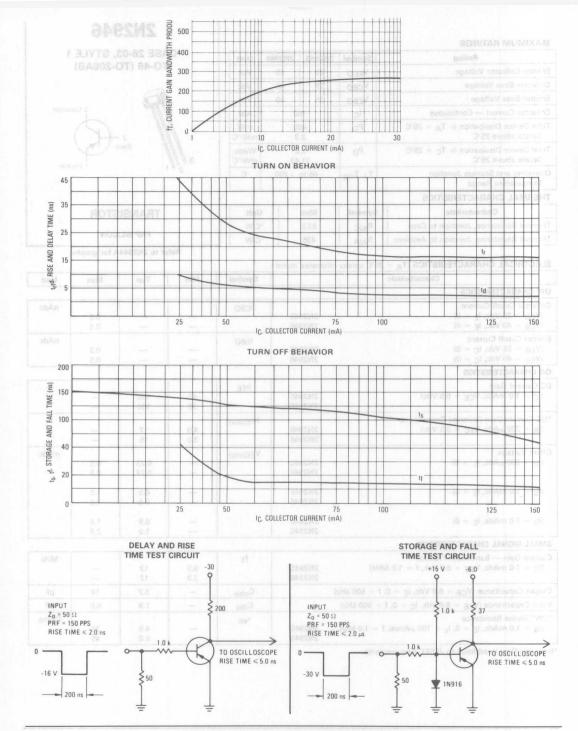
							. 14	IVIGA	UIIIL
Collector-Emitter Saturation Voltage(1 ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)	MS				VCE(sat)	_	-854	0.4	Vdc
Base-Emitter Saturation Voltage	8.75	Unit	Suffix	A M	VBE(sat)	Symbol		geritus?	Vdc
(I _C = 150 mAdc, I _B = 15 mAdc)(1) (I _C = 500 mAdc, I _B = 50 mAdc)					6N	VCEO	_ 885	1.3	ollector
SMALL-SIGNAL CHARACTERISTICS		- Vdg		00		OBOV		ase Voltag	-totaliol
Current-Gain — Bandwidth Product(2)		Vdc		0.8	fT	200	_	estay benege	MHz
$(I_C = 50 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz})$		sbAm		008		31	ontinuous	- Inequi)	somelio.
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)					C _{obo}	-	_	8.0	pF
Input Capacitance (VBF = 2.0 Vdc, IC = 0, f = 100 kHz)		Wm	908	00a	Cibo	04-	— noi	2500	vsO pF
SWITCHING CHARACTERISTICS		D. Went	82.8	2.28	3,43			Dick evod	9Jsnetl
Turn-On Time 1 3.11 18 .80-85 38	30 Vdc, IC = 150 mA	- north			ton	69_	26	45	ns
Delay Time (V _{CC} = 30		150 mAdc,		1.8	td		6.0	10	ns
Rise Time	made/			DS + 01 8	e t _r	ata T. T. Tata	20	40	ns
Turn-Off Time MODIAN MAY					toff		70	100	ogmns
Storage Time $(V_{CC} = 6.0 \text{ Vdc}, I_C)$ Fall Time $I_{B1} = I_{B2} = 15 \text{ mA}$					ts	_	50	80	ns
		-1		alvention	25 Catalesa	TICSLITA	20	30	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0.%

(2) f_T is defined as the frequency at which |h_{fe}| extrapolates to unity.







MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Rating	Symbol	2N2945	2N2946	Unit
Emitter-Collector Voltage	VECO	20	35	Vdc
Collector-Base Voltage	VCBO	25	40	Vdc
Emitter-Base Voltage	VEBO	25	40	Vdc
Collector Current — Continuous	lc	100		Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	400 2.3		mW mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	2.0 11.43		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{ heta JC}$	87.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	435	°C/W

2N2945 2N2946

2N29GA, A. 2N29GS, A. 2N29GS, A. 2N29GF, A. 2N349S, A. 2N349S, A.

CASE 26-03, STYLE 1 TO-46 (TO-206AB)



TRANSISTOR

PNP SILICON

Refer to 2N2944A for graphs.

ELECTRICAL	CHARACTERISTICS	(TA	= 25°C unless otherwise noted.)	
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Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					2 -
Collector Cutoff Current (V _{CB} = 25 Vdc, I _E = 0) 2N2945 (V _{CB} = 40 Vdc, I _E = 0) 2N2946	ICBO 08	ts		0.2 0.5	nAdc
Emitter Cutoff Current (V _{EB} = 25 Vdc, I _C = 0) (V _{EB} = 40 Vdc, I _C = 0) 2N2946	IEBO MAUT	=	=	0.2 0.5	nAdc
ON CHARACTERISTICS			Label		0.14
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 0.5 Vdc) 2N2945 2N2946	hFE	40 30	160 130		n Switt Class
*DC Current Gain (Inverted Connection) (IB = $200 \ \mu Adc, V_{EC} = 0.5 \ Vdc)$ 2N2945 2N2946	hFE(inv)	4.0	17 15	==	17 M
Offset Voltage (IB = 200 μ Adc, IE = 0) 2N2945 2N2946	VEC(ofs)		0.23 0.27	0.5 0.8	mVdc
(I _B = 1.0 mAdc, I _E = 0) 2N2945 2N2946		計主工	0.5 0.6	1.0	
$(I_B = 2.0 \text{ mAdc}, I_E = 0)$ $2N2945$ $2N2946$	ic can	25	0.9 1.0	1.6 2.5	
SMALL-SIGNAL CHARACTERISTICS		3816 (DELAY AND		
Current-Gain — Bandwidth Product $(I_C = 1.0 \text{ mAdc}, V_{CE} = 6.0 \text{ Vdc}, f = 1.0 \text{ MHz})$ 2N2945 2N2946	f _T	5.0 3.0	13 12	_	MHz
Output Capacitance (V _{CB} = 6.0 Vdc, I _E = 0, f = 500 kHz)	Cobo		3.2	10	pF
Input Capacitance (VEB = 6.0 Vdc, IC = 0, f = 500 kHz)	Cibo	015 -	1.9	6.0	pF
"ON" Series Resistance (IB = 1.0 mAdc, IE = 0, IC = 100 μ Arms, f = 1.0 kHz) 2N2945 2N2946	rec	1=	4.5 5.0	35 45	Ohms

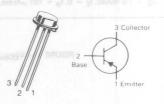
The bottle of the contract of				
Rating S.S.	Symbol	2N2945A	2N2946A	Unit
Emitter-Collector Voltage	VECO	20	35	Vdc
Collector-Base Voltage	VCBO	25	40	Vdc
Emitter-Base Voltage	VEBO	25	40	Vdc
Collector Current — Continuous	IC	1	00	mAdd
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	400 2.3		mW mW/°(
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	2.0 11.43		Watts mW/°0
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C
Lead Temperature 1/16" from Case for 10 seconds	TL	240		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	435	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	87.5	°C/W

2N2945A 2N2946A

JAN, JTX, JTXV AVAILABLE CASE 26-03, STYLE 1 TO-46 (TO-206AB)



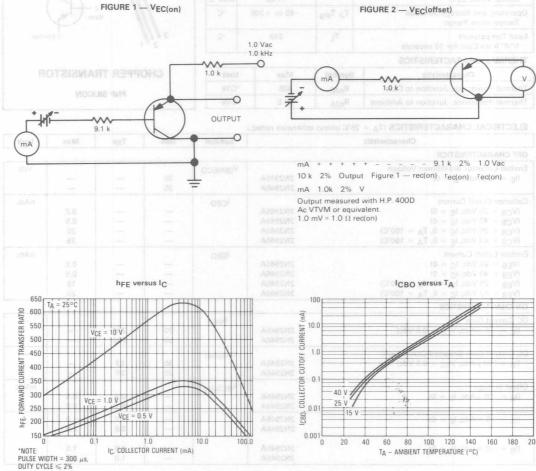
CHOPPER TRANSISTOR

PNP SILICON

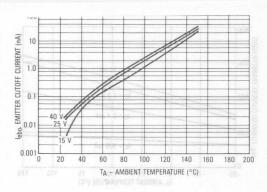
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

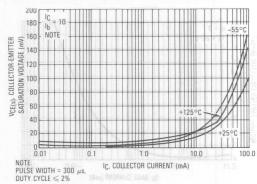
Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						-
Emitter-Collector Breakdown Voltage ($I_E = 10 \mu Adc$, $I_B = 0$)	2N2945A 2N2946A	V(BR)ECO	20 35	_	=	Vdc
Collector Cutoff Current (VCB = 25 Vdc, IE = 0) (VCB = 40 Vdc, IE = 0) (VCB = 25 Vdc, IE = 0, TA = 100°C) (VCB = 40 Vdc, IE = 0, TA = 100°C)	2N2945A	ICBO		=	0.2 0.5 20 25	nAdc
Emitter Cutoff Current (VEB = 25 Vdc, I _C = 0) (VEB = 40 Vdc, I _C = 0) (VEB = 25 Vdc, I _C = 0, T _A = 100°C) (VEB = 40 Vdc, I _C = 0, T _A = 100°C)	2N2945A 2N2946A 2N2945A 2N2946A	IEBO	—5) sin	195 344 	0.2 0.5 15 20	nAdc
ON CHARACTERISTICS						
DC Current Gain (IC = 1.0 mAdc, VCE = 0.5 Vdc)	2N2945A 2N2946A	hFE	70 50	200 200		- 1984 - S
DC Current Gain (Inverted Connection) (IB = 200 μ Adc, VEC = 0.5 Vdc)	2N2945A 2N2946A	hFE(inv)	30 20	32 25		400-
Offset Voltage (IB = 200 μ Adc, IE = 0)	2N2945A 2N2946A	VEC(ofs)		0.4 0.7	0.5 0.8	mVdc
$(I_B = 1.0 \text{ mAdc}, I_E = 0)$	2N2945A 2N2946A	1		0.5 0.6	1.0 2.0	Hom H
$(I_B = 2.0 \text{ mAdc}, I_E = 0)$	2N2945A 2N2946A	1,00) 0.91	O (Ani) T ab aliko R	0.9	1.5	370/1

Output Capacitance		Cobo	-	3.2	10	pF
$(V_{CB} = 6.0 \text{ Vdc}, I_{E} = 0, f = 0.1 \text{ MHz to } 1.0 \text{ MHz})$	35	Vecc 20	4.5	913	stlet/repaile	D-tetlimi
Input Capacitance (VEB = 6.0 Vdc , IC = 0.1 MHz to 1.0 MHz)		C _{ibo}	-	1.9	6.0	pF
"ON" Series Resistance (I _B = 1.0 mAdc, I _E = 0, I _B = 100 μArms, f = 1.0 kHz)	2N2945A	rec(on)		5.0	6.0	Ohms
	2N2946A	- 80	- 3%	7.0	8.0	velO listo









VBE(on) versus IC

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-55°C

-55°C

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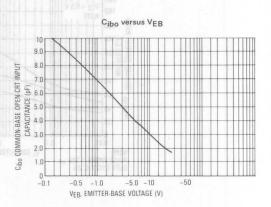
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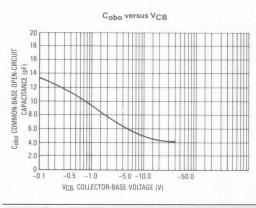
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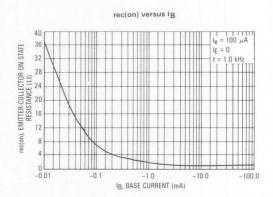
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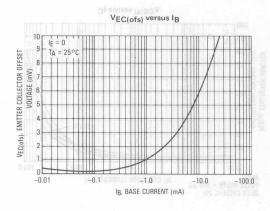
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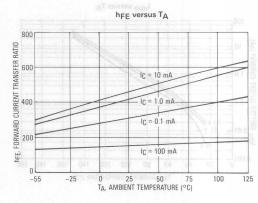


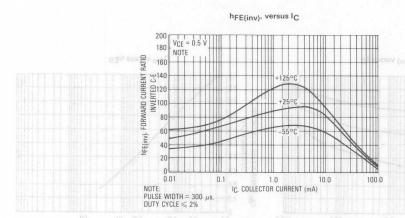


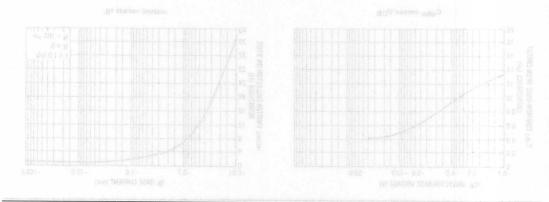


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





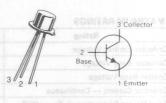




Rating	Symbol	Value	Unit
Collector-Emitter Voltage(1)	VCEO	12	Vdc
Collector-Emitter Voltage	VČES	30	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous Peak (10 μs Pulse)	Ic	200 500	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.36 2.06	Watt mW/°C
Total Device Dissipation (a $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above 25°C	P _D	1.20 0.68 6.85	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	or 3.c

2N3011

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N2368 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic			Min	Max	Unit
OFF CHARACTERISTICS				SOLIENBELOS	ARAHO 11
Collector-Emitter Breakdown Voltage	(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	905 12	sper Breakd	Vdc
Collector-Emitter Breakdown Voltage	$(I_C = 10 \mu Adc, V_{BE} = 0)$	V(BR)CES	30	itter Sustain	Vdc
Collector-Base Breakdown Voltage ($I_{C} = 10 \ \mu Adc, I_{E} = 0)$	V(BR)CBO	30		Vdc
Emitter-Base Breakdown Voltage (IE	= 100 μAdc, I _C = 0)	V(BR)EBO	5.0	annekdenett	Vdc
Collector Cutoff Current $(V_{CE} = 20)$ $(V_{CE} = 20)$	$Vdc\ V_{BE}=0)$ $Vdc\ V_{BE}=0$, $T_{A}=+85^{\circ}C)$	CES	0.8 = 30V)	0.4	μAdc
Base Cutoff Current (VCE = 20 Vdc	V _{BE} = 0)	IBL	0.0 304	0.4	μAdc
ON CHARACTERISTICS (2)	1 91 - 1		387 1157 5	S CARROLICANO	SERVICE DA
DC Current Gain	$(I_C = 10 \text{ mAdc}, V_{CE} = 0.35 \text{ Vdc})$ $(I_C = 30 \text{ mAdc}, V_{CE} = 0.4 \text{ Vdc})$ $(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	hFE	30 25 12	120 	Current C
Collector-Emitter Saturation Voltage	$ \begin{aligned} &\{I_C = 10 \text{ mAdc, } I_B = 1.0 \text{ mAdc}\} \\ &\{I_C = 30 \text{ mAdc, } I_B = 3.0 \text{ mAdc}\} \\ &\{I_C = 100 \text{ mAdc, } I_B = 10 \text{ mAdc}\} \\ &\{I_C = 10 \text{ mAdc, } I_B = 1.0 \text{ mAdc, } T_A = +85^\circ\text{C}\} \end{aligned} $	VCE(sat)	1,0 Vdoj(1 ion V <u>ol</u> lage(1 0 m <u>Ad</u> s)	0.20 0.25 0.50 0.30	001 Vdc
Base-Emitter Saturation Voltage	$(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$ $(I_C = 30 \text{ mAdc}, I_B = 3.0 \text{ mAdc})$ $(I_C = 100 \text{ mAdc}, I_B = 10 \text{ mAdc})$	V _{BE} (sat)	0.72 (ob=m 0)	0.87 1.15 1.60	Vdc
SMALL-SIGNAL CHARACTERISTICS	(ma)36*		(abAm 0.	= gl_obAr	0 (= 5)
Current-Gain — Bandwidth Product	$(I_C = 20 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz})$	fT	400	= gLabAr	MHz
Output Capacitance (V _{CB} = 5.0 Vdd	c, I _E = 0, f = 140 kHz)	Cobo	(SDAM Ur	4.0	pF
SWITCHING CHARACTERISTICS			SOLI GINGTO	APRIL LINE	MALE SHAR
Storage Time $(I_C = I_{B1} = -I_{B2} = 10 \text{ mAdc})$	000	t _s	0,1 = T40 kH	13	ns
Turn-On Time $(V_{CC} = 2.0 \text{ Vdc}, V_{EB(off)} = 0, I_{C} = 0)$	= 30 mAdc, I _{B1} = 3.0 mAdc)	t _{on}	140 Da T = 1,60 Tall	= 115 _b v 8	ns
Turn-Off Time (V _{CC} = 2.0 Vdc, I _C = 30 mAdc, I _B	$1 = -I_{B2} = 3.0 \text{ mAdc}$	toff our	= 1 .seV 01	20	ns

⁽²⁾ Pulse Test: Pulse Length = 30 μ s, Duty Cycle \leq 2.0%.

ZN3011

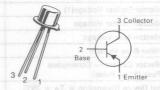
CASE 22-03, STYLE 1 TO-18 (TO-2866A)

MAXIMUM RATINGS

MAXIMOM NATINGS			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	12	Vdc
Collector-Base Voltage	VCBO	12	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.36 2.06	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 6.85	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	o) 2°C

2N3012

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N869A for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

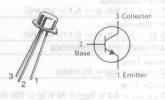
tint1 vota	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					CTERISTICS	OFF CHARA
Collector-Emitter Breakdow	n Voltage ($I_C = 10 \mu A$	dc, V _{BE} = 0)	V(BR)CES	12	inter Bresta	Vdc
Collector-Emitter Sustaining		mAdc, I _B = 0) lase Termination — Open Base)	VCEO(sus)	12 12	Iner D reakd	Vdc
Collector-Base Breakdown \	Voltage (I _C = 10 μAdo	:, IE = 0)	V(BR)CBO	12	TOURDETC CO	Vdc
Emitter-Base Breakdown Vo	oltage (I _E = 100 μAdc,	$I_{C} = 0$	V(BR)EBO	4.0	THE CONTRACTOR	Vdc
Collector Cutoff Current (\(\)(\)	V _{CE} = 6.0 Vdc, V _{BE} = 0 V _{CE} = 6.0 Vdc, V _{BE} = 0		o lces	(VCE = 20	80 5.0	μAdc
Base Current (VCE = 6.0	Vdc, V _{BE} = 0)		IB	204 A2 - 3	30	μAdc
ON CHARACTERISTICS				(3)	- CONTROL OF	The same of the
DC Current Gain (IC = 10 mAdc, VCE = 0 (IC = 30 mAdc, VCE = 0 (IC = 100 mAdc, VCE = 0	.5 Vdc)	s, V _{CE} = 0.4 Vdc) dc, V _{CE} = 1.0 Vdc) c, la = 1.0 mAdo)	(IC = 100 mA	25 30 20	120	ntS-respelled
Collector-Emitter Saturation (IC = 10 mAdc, IB = 1.0	n Voltage(1) mAdc)	c, 1g = 3.5 mAdc) dc, 1g = 10 mAdc) c, 1g = 1.0 mAdc, T _A = +85°C)	VCE(sat)	_	0.15	Vdc
(I _C = 30 mAdc, I _B = 3.0 (I _C = 100 mAdc, I _B = 10	$mAdc$, $T_A = +85$ °C)	tig = 1.0 mAde) t. lg = 3.0 mAdel		<u>ep</u> stioV	0.2 0.4 0.5	with mill-exec
Base-Emitter Saturation Vo	mAdc)	Construction — Birth	V _{BE(sat)}	0.78	0.98	Vdc
$(I_C = 30 \text{ mAdc}, I_B = 3.0)$ $(I_C = 100 \text{ mAdc}, I_B = 10)$			(tg = 20 mAds	0.85	1.2	Current-Gara
SMALL-SIGNAL CHARACT	ERISTICS	1000		anyata g		CALLY AND DESIGNATION
Output Capacitance (VCB = 5.0 Vdc, I _E = 0,	f = 140 kHz)		C _{obo}	(shAcs 0	6.0	pF pF pF pF pF pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0,	f = 140 kHz)	Internal	Cibo		6.0	pF
Small-Signal Current Gain (I _C = 30 mAdc, V _{CE} = 1	0 Vdc, f = 100 MHz)	Johnson d	h _{fe}	4.0		niT 10-mu
SWITCHING CHARACTERIS	STICS	A common de la com	(Supplied)	Arc Of set A	ra to n mani	alds siles A
Turn-On Time	(V _{CC} = 2.0 Vdc, I _C ≈30	mAdc, I _{B1} ≈1.5 mAdc)	to ston	au se = d	pns 60 kg	es Tens A
Turn-Off Time	(V _{CC} = 2.0 Vdc, I _C ≈30	mAdc, I _{B1} = I _{B2} ≈1.5 mAdc)	toff	_	75	ns

Rating	Symbol	Value	Unit
Collector-Emitter Voltage(1) 2N3013 2N3014	VCEO	15 20	Vdc
Collector-Emitter Voltage	VCES	40	Vdc
Collector-Base Voltage	Vсво	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous (10 μs pulse) Peak	lc	200 500	mAdc
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	0.36 2.06	Watt mW/°C
Total Device Dissipation (a $T_C = 25^{\circ}C$ (a $T_C = 100^{\circ}C$ Derate above 25°C	PD	1.20 0.68 6.85	Watts Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

⁽¹⁾ Applicable from 0.01 mA to 10 mA (Pulsed)

2N3013 2N3014

JAN, JTX AVAILABLE CASE 27-02, STYLE 1 TO-52 (TO-206AC)



SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N3648 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)		V(BR)CES	40	-	Vdc
Collector-Emitter Sustaining Voltage(2) $(I_C = 10 \text{ mAdc}, I_B = 0)$	2N3013 2N3014	VCEO(sus)	15 20	=	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)		V _(BR) CBO	40	-	Vdc
Emitter-Base Breakdown Voltage $(I_E = 100 \mu Adc, I_C = 0)$		V _{(BR)EBO}	5.0	=	Vdc
Collector Cutoff Current (VCE = 20 Vdc, VBE = 0) (VCE = 20 Vdc, VBE = 0, TA = +125°C)		ICES	=	0.3 40	μAdd
Base Current (V _{CE} = 20 Vdc, V _{BE} = 0)		IB	-	0.3	μAdd
ON CHARACTERISTICS(2)					
DC Current Gain $ \begin{aligned} &(I_C = 30 \text{ mAdc, } V_{CE} = 0.4 \text{ Vdc}) \\ &(I_C = 100 \text{ mAdc, } V_{CE} = 0.5 \text{ Vdc}) \\ &(I_C = 10 \text{ mAdc, } V_{CE} = 0.4 \text{ Vdc}) \\ &(I_C = 300 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 100 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 300 \text{ mAdc, } V_{CE} = 0.4 \text{ Vdc, } T_A = -55^{\circ}C) \end{aligned} $	2N3013 2N3014 2N3013 2N3014	hFE	30 25 25 15 25 12	120 — — — — —	_
Collector-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 300 mAdc, I _B = 3.0 mAdc) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 30 mAdc, I _B = 3.0 mAdc, T _A = +125°C)	2N3013 2N3014 2N3013 2N3014	VCE(sat)		0.18 0.28 0.35 0.50 0.18 0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 10 mAdc, I _B = 1.0 mAdc)	2N3013 2N3014	VBE(sat)	0.75 — — 0.70	0.95 1.20 1.70 0.80	Vdc

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic			Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS	steU	spicy	todraye		garlan	
Current-Gain — Bandwidth Product (IC = 30 mAdc, VCE = 10 Vdc, f = 100 MHz)	Vac	81	030 ft	350	TagetloV test	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 140 kHz)			C _{obo}	-	5.0	pF m - mostle
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 140 kHz)	Vdc	60.0	Cibo		8.0	pF
SWITCHING CHARACTERISTICS	otsAm	000	1 31	shon	ent — Contin	nu3 sersulie
Storage Time (I _C = I _{B1} = I _{B2} = 10 mAdc)	the VV	80.0	t _S	TA = 25°C	18	ns activact tase
Turn-On Time $(V_{EB(off)} = 5.0 \text{ V}, V_{CC} = 15 \text{ V}, I_{C} = 300 \text{ mAdc}, I_{B1} = (V_{EB(off)} = 0, V_{CC} = 2.0 \text{ V}, I_{C} = 30 \text{ mAdc}, I_{B1} = 3.0 \text{ mAdc}, I_{B1} = 3$	2N3013	0.05 0.12 0.03 0.83	ton	Tc = 25°C Tc = 100°C	n noisepasid	ns source other
Turn-Off Time $(VCC = 15 \text{ V, } I_C = 300 \text{ mAdc, } I_{B1} = I_{B2} = 30 \text{ mAdc})$ $(V_{CC} = 2.0 \text{ V, } I_C = 30 \text{ mAdc, } I_{B1} = I_{B2} = 3.0 \text{ mAdc})$			t _{off}	(1) Am 01 or		ns ns ns T

(2) Pulse Test: Pulse Width = 300 μ s, Duty Cycle \leq 2.0%.

Max			
			Collecto - emitter Bregisdown Voltage IIC = 100 pAdds Vgg = 01
		2N3013	
			DC Duri ant Gain (It = 30 mAdc, Vgg = 0.4 Vdc) (It = 100 mAdc, Vgg = 0.5 Vdc) (It = 10 mAdc, Vgg = 0.4 Vdc) (It = 300 mAdc, Vgg = 1.0 Vdc) (It = 300 mAdc, Vgg = 1.0 Vdc) (It = 300 mAdc, Vgg = 1.4 Vdc)

MAXIMUM	RATINGS					
Unit	Rating	nika	Symbol	2N3019 2N3020	2N3700	Unit
Collector-Em	itter Voltage		VCEO	80	80	Vdc
Collector-Ba	se Voltage		VCBO	140	140	Vdc
Emitter-Base	Voltage		VEBO	7.0	7.0	Vdc
Collector Cu	rrent — Contin	uous	old IC	1.0	1.0	Adc
Total Device Derate abo	Dissipation @ ove 25°C	$T_A = 25^{\circ}C$	PD	0.8 4.6	0.5 2.85	Watts mW/°C
Total Device Derate abo	Dissipation @	$T_C = 25^{\circ}C$	PD	5.0 28.6	1.8 10.6	Watts mW/°C
Operating as	nd Storage Jur ure Range	nction	T _J , T _{stg}	- 65 to	+200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	2N3019 2N3020	2N3700	Unit
Thermal Resistance, Junction to Case	$R_{\theta}JC$	16.5	70	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	89.5	245	°C/W



GENERAL TRANSISTOR

NPN SILICON

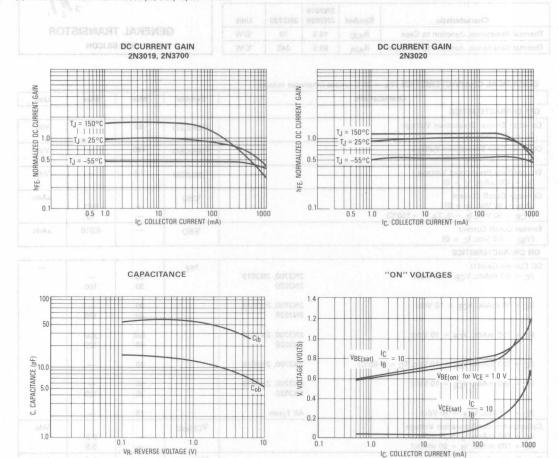
FLECTRICAL	CHARACTERISTICS	(TA	=	25°C unless otherwise noted	1)
ELECTRICAL	CHANACTERISTICS	ILA	-	25 C uniess otherwise note	2.1

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		The Little			- 8
Collector-Emitter Breakdown Voltage (I _C = 30 mAdc, I _B = 0)	6 8	V(BR)CEO	80	30 <u>031</u> = (f)	Vdc
Collector-Base Breakdown Voltage (I _C = 100 µAdc, I _E = 0)		V(BR)CBO	140	11(+) 10 = -55°C mm	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)		V(BR)EBO	7.0		Vdc
Collector Cutoff Current (V _{CB} = 90 Vdc, I _E = 0) (V _{CB} = 90 Vdc, I _E = 0, T _A = +150°C)		СВО		0.01 10	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)		IEBO	31/00 OI	0.010	μAdc
ON CHARACTERISTICS					
DC Current Gain(1) (I _C = 0.1 mAdc, V _{CE} = 10 Vdc)/ MO	2N3700, 2N3019 2N3020	hFE	50 30	_ 100	_
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3700, 2N3019 2N3020		90 40	120	601
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3700, 2N3019 2N3020		100 40	300 120	Jug.
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, T_C = -55^{\circ}\text{C})$	2N3700, 2N3019	4	40		0.01
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3700, 2N3019 2N3020		50 30	100	08
(I _C = 1.0 Adc, V _{CE} = 10 Vdc)	All Types		15		
Collector-Emitter Saturation Voltage (IC = 150 mAdc, Ig = 15 mAdc)		V _{CE(sat)}		0.2	Vdc
(I _C = 500 mAdc, I _B = 50 mAdc) Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)		V _{BE(sat)}	325303E W	1.1	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	2N3020 2N3019, 2N3700	fT	80 100	400	MHz

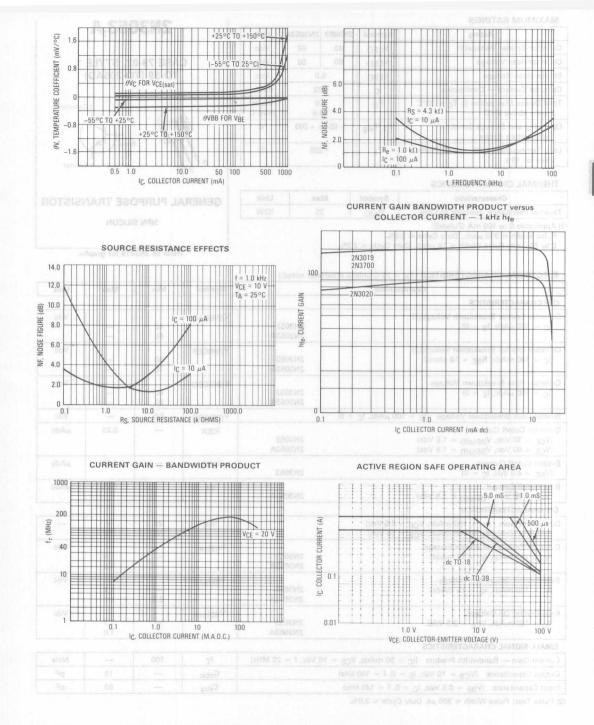
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic			Procus	Symbol	Min	Max	Unit
Output Capacitance				C _{obo}	_	12	pF
$(V_{CB} = 10 \text{ Vdc}, I_{E} = 0, f = 1.0 \text{ MHz})$	otiV	- 08	- 89	VOEC		sgalleV rotti	
Input Capacitance	Velc	140	040	Cibo	_	60 / 9	a pFallo
$(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$	New York	0.5	0.5	Neger		specieu	ear Exection
Small-Signal Current Gain (IC = 1.0 mAdc, VCF = 5.0 Vdc, f = 1.0 kHz)		2N3700, 2N	J3019	h _{fe}	80	400	allector Cu
, CE		2N3020		09	30	200	
Collector Base Time Constant	O West	(18.5)	0.5	rb'Cc		n ez en	ps
(IF = 10 mAdc, VCB = 10 Vdc, f = 79.8 MHz)		2N3019, 2N	13020	09	ores = of o	400	otal Darion
CB		2N3700			15	400	
Noise Figure	3"	+ 200	01 88 -	NF	notion_	L 99 4 12 L	
$(I_C = 100 \mu Adc, V_{CE} = 10 Vdc,$		2N3019,				ro Pange	
$R_S = 1.0 \text{ k ohms}, f = 1.0 \text{ kHz}$		2N3700					

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.0%.







Rating	Symbol	2N3053	2N3053A	Unit
Collector-Emitter Voltage(1)	VCEO	40	60	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	5	5.0	Vdc
Collector Current — Continuous	IC	700		mAdc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C
Lead Temperature 1/16", ±1/32" From Case for 10 s	TL.	+ 235		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W

(1) Applicable 0 to 100 mA (Pulsed):
Pulse Width ≤ 300 µsec., Duty Cycle ≤ 2.0%.

0 to 700 mA; Pulse Width \leq 10 μ sec., Duty Cycle \leq 2.0%.

2N3053,A

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CASE 79-02, STYLE 1 TO-39 (TO-205AD)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

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pF

Cibo

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	E MALL				Hoo
Collector-Emitter Breakdown Voltage(2) (IC = 100 µAdc, IB = 0)	2N3053 2N3053A	V(BR)CEO	40 60		Vdc
Collector-Emitter Breakdown Voltage(2) (I _C = 100 mAdc, R _{BE} = 10 ohms)	2N3053 2N3053A	V(BR)CER	50 70	$\perp \neq \perp$	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	2N3053 2N3053A	V(BR)CBO	60 80		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)		V(BR)EBO	5.0	2 of 2	Vdc
Collector Cutoff Current Waldes Wal	2N3053 2N3053A	ICEX		0.25	μAdd
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	2N3053	I EBO	MAS — MIAS	0.25	μAdd
Base Cutoff Current (VCE = 60 Vdc, VBE(off) = 1.5 Vdc)	2N3053A	IBL		0.25	μAdd
ON CHARACTERISTICS(1)					one
DC Current Gain (I _C = 150 mAdc, V_{CE} = 2.5 Vdc) (I _C = 150 mAdc, V_{CE} = 10 Vdc)		hFE	25 50	 250	-
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	2N3053 2N3053A	VCE(sat)		1.4 0.3	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	2N3053 2N3053A	VBE(sat)	0.6	1.7 1.0	Vdc
Base-Emitter On Voltage (I _C = 150 mAdc, V _{CE} = 2.5 Vdc)	2N3053 2N3053A	V _{BE(on)}	11 1 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1.7 1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				THE RESERVE	
Current-Gain — Bandwidth Product ($I_C = 50 \text{ mAdc}$, $V_{CE} = 10 \text{ N}$	/dc, f = 20 MHz)	fT	100		MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_{E} = 0$, $f = 140 \text{ kHz}$)		C _{obo}	_	15	pF
1 C (1/ 0.5)/d- 1 0.6 140 [1]->					

Input Capacitance ($V_{BE} = 0.5 \text{ Vdc}$, $I_{C} = 0$, f = 140 kHz) (2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

2N3073

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N2904 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	60	Vdc
Collector-Base Voltage	V _{CBO}	60	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	lc	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD BIAIT BINIH	360 2.06	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 6.85	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (I _C = 30 mAdc, I _B = 0)	V(BR)CEO	60	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	V(BR)CBO	60		Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	4.0	-	Vdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 0) (V _{CE} = 30 Vdc, V _{BE} = 0, T _A = 125°C)	ICES	=	10 10	nAdc μAdc
Emitter Cutoff Current (V _{EB} = 4.0 Vdc, I _C = 0)	IEBO	<u> </u>	100	μAdc
Base Current (V _{CE} = 30 Vdc, V _{BE} = 0)	IB		10	nAdc
ON CHARACTERISTICS				
DC Current Gain(1) ($I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^{\circ}\text{C}$) ($I_C = 300 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc}$)	hFE	30 12 15	130	_
Collector-Emitter Saturation Voltage $(I_C = 50 \text{ mAdc}, I_B = 2.5 \text{ mAdc})$ $(I_C = 300 \text{ mAdc}, I_B = 30 \text{ mAdc})$	VCE(sat)	=	0.25 1.0	Vdc
Base-Emitter Saturation Voltage $(I_C = 50 \text{ mAdc}, I_B = 2.5 \text{ mAdc})$ $(I_C = 300 \text{ mAdc}, I_B = 30 \text{ mAdc})$	V _{BE} (sat)	=	1.2	Vdc
Base-Emitter On Voltage (I _C = 50 mAdc, V _{CE} = 1.0 Vdc)	VBE(on)	_	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product(2) (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	130	-	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 140 \text{ kHz}$)	C _{obo}	-	10	pF
Input Impedance (IC = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h _{ie}	-	1.5	kohms
Voltage Feedback Ratio ($I_C = 10$ mAdc, $V_{CE} = 10$ Vdc, $f = 1.0$ kHz)	h _{re}	-	26	X 10-4
Small Signal Current Gain (IC = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h _{fe}	25	180	-
Output Admittance (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{oe}		1200	μmhos

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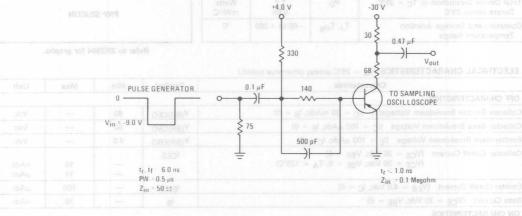
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS				
Turn-On Time (I _C ≈300 mAdc, I _{B1} ≈30 mAdc)	ton	-	40	ns
Turn-Off Time (Ic≈300 mAdc, I _{B1} ≈I _{B2} ≈30 mAdc)	toff	-	100	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.0%.

(2) fT is defined as the frequency at which |hfe| extrapolates to unity.





4HJL14

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N3498 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage(1)	VCEO	150	Vdc
Collector-Base Voltage	Vсво	150	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	lc	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.8 4.57	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

the Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			CTENISTICS	ARAHO THO
Collector-Emitter Breakdown Voltage(2) (IC = = 30 mAdc, IB = 0)	V(BR)CEO	150	itter S esedo Ado, Ig = 0	
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	V(BR)CBO	150 V	ia Br as kdowi Ado, Ig. = 0),	
Emitter-Base Breakdown Voltage (I _E = 100 µAdc, I _C = 0)	V(BR)EBO	5.0	Breaktlown Ado, ig = 0)	
Collector Cutoff Current (V _{CB} = 100 Vdc, I _E = 0) (V _{CB} = 100 Vdc, I _E = 0, T _A = 150°C)	ICBO	_ {V = _	0.010 V	μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, IC = 0)	IEBO	organ = AT	0.10	μAdc
ON CHARACTERISTICS			fnerng:	PhotoDere
DC Current Gain(2) (I _C = 0.1 mAdc, V _{CE} = 10 Vdc) (I _C = 30 mAdc, V _{CE} = 10 Vdc) (I _C = 30 mAdc, V _{CE} = 10 Vdc, T _A = -55°C)	hFE	15 30 12		ON CHARACT
Collector-Emitter Saturation Voltage(2) (I _C = 50 mAdc, I _B = 5.0 mAdc)	VCE(sat)	(f)(p <u>w</u> 6t fleastleV no	1.0 LA	Vdc
Base-Emitter Saturation Voltage(2) (I _C = 50 mAdc, I _B = 5.0 mAdc)	V _{BE} (sat)	falsam 8 (flepsile	10.0	
SMALL-SIGNAL CHARACTERISTICS		(atsAm 8	nAdc, lg =	10 = 150 i
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 140 kHz)	C _{obo}		9.0	P
Input Capacitance (VEB = 0.5 Vdc, IC = 0 , f = 140 kHz)	Cibo	20 Vda, 1 -	80	P
Small-Signal Current Gain (I _C = 1.0 mA, V _{CE} = 5.0 V, f = 1 kHz)	h _{fe}	HS 025 - 1	Vdc_lg = 0 ance	nt - sa Vr tosos0 ruq
Current Gain — High Frequency (V _{CE} = 10 Vdc, I _C = 30 mAdc, f = 20 MHz)	h _{fe}	2.0	rdo, i _C = 0.1 CHARACTER	E = agVi
Real Part of Input Impedance (IC = 10 mA, V_{CE} = 10 V, f = 100 MHz)	Re(h _{ie})	-		Ohms

⁽¹⁾ Between 0 and 30 mA.

⁽²⁾ Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 1.0%.

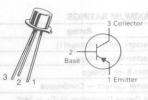
2N3114 CASE 79-02, STYLE TO-39 (TO-20SAD)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	35 35	Vdc
Collector-Base Voltage	VCBO	9BV 50	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC	600	Am 200
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.4	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.8 10.3	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

2N3135

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR PNP SILICON

Refer to 2N2904 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and caseinu 3°CS = ATI 83/T39/H3T3ARAH3 JA3/HT33/J3

Signal Characteristic		Symbol	Min	Max	Unit		
OFF CHARACTERISTICS				TERISTICS			
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	Visriceo	V(BR)CEO	10 10 10 10 10 10 10 10	tter Ereakdı m.Kde, ig			
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_E = 0)_x$	OBORBOA	V(BR)CBO	50	e Brezkotowi Ado, Ig. = 1			
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(8R)EBO	V(BR)EBO	4.0 HeV	RealBown Ado, (g = 4			
Collector Cutoff Current (V _{CE} = 30 V, V _{BE} = 0.5 V)		ICEX	- (0	7/10 0.10 PM			
Collector Cutoff Current $(V_{CB} = 30 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 30 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$		СВО	тат = дт д — — — — — — — — — — — — — — — — — — —	0.05	μAdc		
Base Cutoff Current (VCE = 30 V, VBE = 0.5 V)		IBL	_	80 0.1			
ON CHARACTERISTICS		C = 0.1 mAde, Vcg = 10 Vde)					
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 150 mAdc, V _{CE} = 10 Vdc)(1)		hFE,	25 40	= 30 <u>V</u> 30.4	10 = 3		
Collector-Emitter Saturation Voltage(1) (IC = 150 mAdc, IB = 15 mAdc)	Vostlant	VCE(sat)	0 mAde) oltsge(2)	0.6	Vdc		
Base-Emitter Saturation Voltage(1) (IC = 150 mAdc, IB = 15 mAdc)		VBE(sat)	TERISTICS	1.5	Vdc		
SMALL-SIGNAL CHARACTERISTICS	0000			eans)	iput Capac		
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = 1	00 MHz)	f _T	200	, 80% 0 = 31 '20 A	MHz		
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$	elif	C _{obo}	PIE OPI = 1	10 (s) (serve			
Input Capacitance (V _{BE} = 2 Vdc, I _C = 0, f = 100 kHz)	letd	Cibo		40			
SWITCHING CHARACTERISTICS		(sHA) Us	= 1,00Am	ar a Ji bu	01 - 30		
Turn-On Time $(V_{CC} = 30 \text{ V, } I_{C} = 150 \text{ mA, } I_{B1} = 18 \text{ ma})$	5 mA)	ton (KHA)	26	75	ns ns		
Turn-Off Time (V _{CC} = 6.0 V, I _C = 150 mA, I _{B1} = I ₁	B2 = 15 mA)	toff	70	150	ns		

INIAAIIVIOIVI NATIIVUS				
Rating	Symbol	2N3244	2N3245	Unit
Collector-Emitter Voltage	VCEO	40	50	Vdc
Collector-Base Voltage	VCBO	40	50	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	IC	1.0		Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	1.0 5.71		Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

THERMAL CHARACTERISTICS

OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage(1)

($I_C = 1.0 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc}$)

Collector-Emitter Saturation Voltage(1)

(IC = 150 mAdc, IB = 15 mAdc)

 $(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$

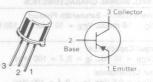
 $(I_C = 1.0 \text{ Adc}, I_B = 100 \text{ mAdc})$

THE THIRD CONTROL OF THE THE THE THE THE THE THE THE THE THE								
Characteristic	Symbol	Max	Unit					
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W					
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.175	°C/mW					

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.) Characteristic

2N3244 2N3245

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Max

Unit

Vdc

Vdc

0.3

0.35

0.5

0.6

1.0

1.2

Min

25

20

VCE(sat)

Symbol

V(BR)CEO

$(I_C = 10 \text{ mAdc}, I_B = 0)$	2N3244 2N3245	(511/520	40 50		
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	2N3244 2N3245	V(BR)CBO	40 50	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	MINIMUM DURRENT BAIN CHARACTERISTICS	V(BR)EBO	5.0	-	Vdc
Base Cutoff Current (VCE = 30 Vdc, VBE = 3.0 Vdc)	125%	IBEV	7-1	80	nAdc
Collector Cutoff Current (VCE = 30 Vdc, VBE = 3.0 Vdc)		ICEX	-	50	nAdc
$ \begin{array}{lll} \mbox{Collector Cutoff Current} \\ \mbox{(V}_{\mbox{CB}} = 30 \mbox{ Vdc, I}_{\mbox{E}} = 0) \\ \mbox{(V}_{\mbox{CB}} = 30 \mbox{ Vdc, I}_{\mbox{E}} = 0, \mbox{ T}_{\mbox{A}} = 100 \mbox{^{\circ}C}) \end{array} $		ICBO	5 <u>-</u>	0.050	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, I _C = 0) (VEB = 4.0 Vdc, I _C = 0)	2N3245 2N3244	IEBO		30 30	nAdc
ON CHARACTERISTICS					
DC Current Gain(1) (I _C = 150 mAdc, V _{CE} = 1.0 Vdc)	2N3244 2N3245	hFE	60 35		-
(I _C = 500 mAdc, V_{CE} = 1.0 Vdc)	2N3244 2N3245	00	50	150	0.2

2N3244

2N3245

2N3244

2N3245

2N3244

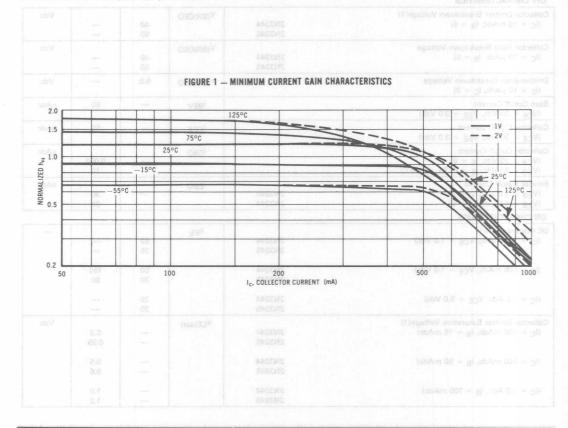
2N3245

2N3244

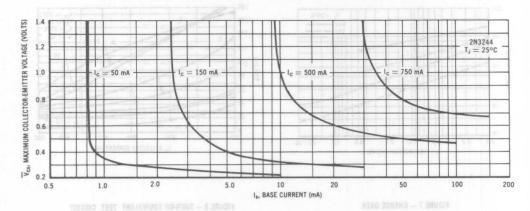
2N3245

Characteristic					Symbol	Min	Max	Unit
Base-Emitter Saturation V	/oltage(1)			V _{BE} (sat)		SOMMAS	Vdc	
(I _C = 150 mAdc, I _B = 1	15 mAdc)			28/3244	Symbol	_	enth1.1	
(I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)					osaV Veso	0.75	1.5	
SMALL-SIGNAL CHARAC	CTERISTICS	2014	9.0	UR	0807		page 1 and 1 and	SC-JOLIOEU
Current-Gain — Bandwidt	th Product	20%	V	C	OB fT		aganov	MHz
(I _C = 50 mAdc, V _{CE} =	10 Vdc, f = 100 MHz)		2N32	44	3)	175 0 00	med = than	of nomalic
	11.32	mW	2N32	45	69	150	notzacianiO	
Output Capacitance			5.71		Cobo	_	25	pF
$(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$		atteVV	5.0		m9	To = 2810	Discipation in	tal Device
Input Capacitance					Cibo	_	100	pF
$(V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0)$), f = 100 kHz)	3"	-200	-85.10	DIST OF	naitan	Legmord be	re poiterno
SWITCHING CHARACTER	RISTICS							
Delay Time	W- 1500 A I- 50		2N32	144	t _d	_	15	ns
Rise Time	(I _C = 500 mA, I _{B1} = 50 V _{EB} = 2.0 V, V _{CC} = 30		2N32		Symbol	- sid	35 40	ns
Storage Time		V/31	3	8	DENA ts	ion la Case	140	ns
$(I_C = 500 \text{ mA}, V_{CC} = 300 \text{ mA})$		V Went		2N3244	lete B In	ion to Amble	120	en R termina
Fall Time I _{B1} = I _{B2} = 50 mA)		-	211/32	2N3245		_	45	ns
Total Control Charge (I _C = 500 mA, I _B = 50 mA, V _{CC} = 30 V)			2N32	244	Q _T	1 ESTEPPE	DARA140 JA	рС
			2N32	245	alitable attacks	-	12	

(1) Pulse Test: PW \leq 300 μ s, Duty Cycle \leq 2.0%.



23MT 2005-27 FIGURE 2 — COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS 101 — 8 390004



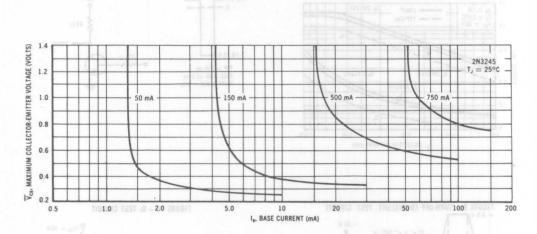


FIGURE 3 - MAXIMUM SATURATION VOLTAGES

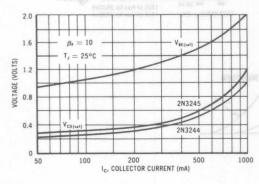
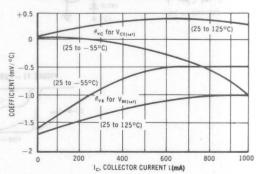
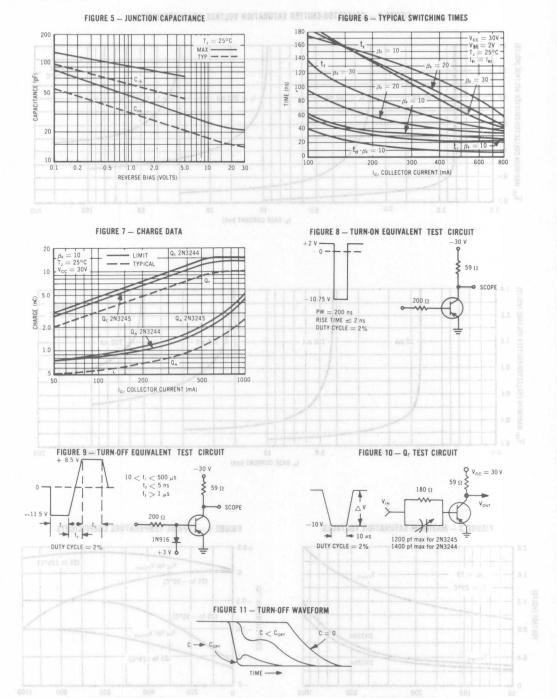


FIGURE 4 - TYPICAL TEMPERATURE COEFFICIENTS







2N3249

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





SWITCHING TRANSISTOR

PNP SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	12	Vdc
Collector-Base Voltage	Vсво	15	Vdc
Emitter-Base Voltage	V _{EBO}	5.0	Vdc
Collector Current — Continuous	Ic	200	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.36 2.06	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 6.9	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	, noted.,	W 1 11	3 2 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO	12 - 3 - 5 349	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	15 m	13-T.L	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	5.0	4-4	Vdc
Base Cutoff Current (V _{CE} = 10 Vdc, V _{BE} = 1.0 Vdc)	IBEV	6 -	50	nAdd
Collector Cutoff Current (V _{CE} = 10 Vdc, V _{BE} = 1.0 Vdc) (V _{CE} = 10 Vdc, V _{BE} = 1.0 Vdc, T _A = 100°C)	ICEX and after after	*19010 1q 1	0.05 5.0	μAdd
ON CHARACTERISTICS THANKING ACTORNION AND	+0.5 -10.7 -11.3 +8.7	81 4	IN SE	11 601
DC Current Gain(1) (IC = 0.1 mAdc, V _{CE} = 1.0 Vdc) (IC = 1.0 mAdc, V _{CE} = 1.0 Vdc) (IC = 10 mAdc, V _{CE} = 1.0 Vdc) (IC = 50 mAdc, V _{CE} = 1.0 Vdc) (IC = 50 mAdc, V _{CE} = 1.0 Vdc) (IC = 100 mAdc, V _{CE} = 1.0 Vdc)	FE OSSESSION OF STREET	100 100 100 75 35	300	pode tro <u>vil</u> s
Collector-Emitter Saturation Voltage(1) (IC = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	VCE(sat)		0.125 0.25 0.45	Vdc
Base-Emitter Saturation Voltage(1) (IC = 10 mAdc, I _B = 1.0 mAdc) (IC = 50 mAdc, I _B = 5.0 mAdc) (IC = 100 mAdc, I _B = 10 mAdc)	VBE(sat)	0.6 0.7 —	0.9 1.1 1.3	Vdc
SMALL-SIGNAL CHARACTERISTICS				100
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fŢ	300		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}		8.0	pF
Input Capacitance (V _{BE} = 1.0 Vdc, I _C = 0, f = 100 kHz)	C _{ibo}		8.0	pF

Delay Time	$I_C = 100 \text{ mA}, I_B = 10 \text{ mA},$		td	_	5.0	ns
Rise Time	V _{BE} = 0.5 V, V _{CC} = 10 V	$BE = 0.5 \text{ V}, \text{ V}_{CC} = 10 \text{ V}$			15	ns
Storage Time	$I_C = 100 \text{ mA}, I_{B1} = I_{B2} = 10 \text{ mA},$	$I_C = 100 \text{ mA}, I_{B1} = I_{B2} = 10 \text{ mA},$ $V_{CC} = 10 \text{ V}$		_	60	ns
Fall Time	V _{CC} = 10 V			-	20	ns
Turn-On Time	I _C = 10 mA, I _{B1} = 1.0 mA, V _{BE} = 0.5 V, V _{CC} = 3.0 V		ton	_	20V90 R	nu /ns AM
Turn-Off Time	$I_C = 10 \text{ mA}, I_{B1} = I_{B2} = 1.0 \text{ mA},$ $V_{CC} = 3.0 \text{ V}$	\$1	toff toff	-	100 otti	ns ns ns
Total Control Charge	0.25 mA, V _{CC} = 3.0 V)	0.8	Q _T	-		рС

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

FIGURE 1 - ton CIRCUIT

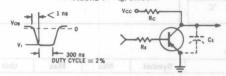
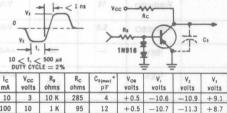


FIGURE 2 - toff CIRCUIT



*Total shunt capacitance of test jig and connectors.

FIGURE 3 - TYPICAL SWITCHING TIMES

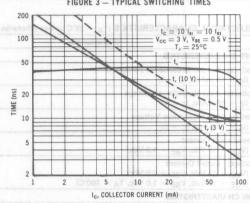
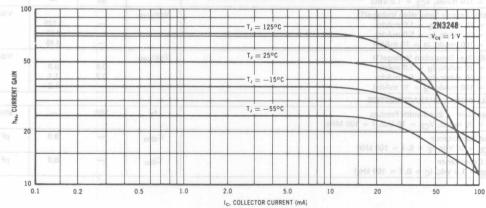
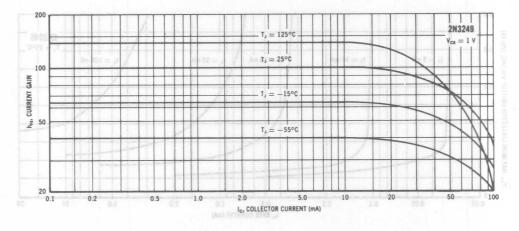
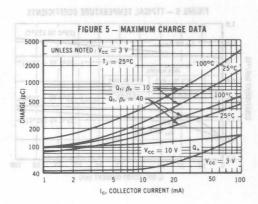


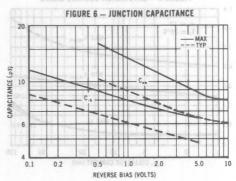
FIGURE 4 - MINIMUM CURRENT GAIN CHARACTERISTICS

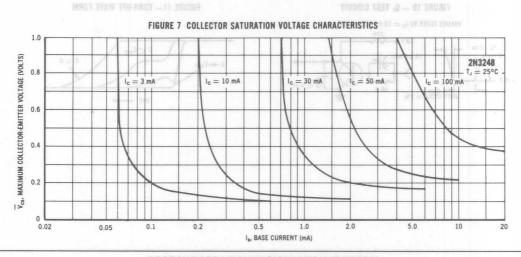


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS OTOUGHOOIMES AJOROTOM



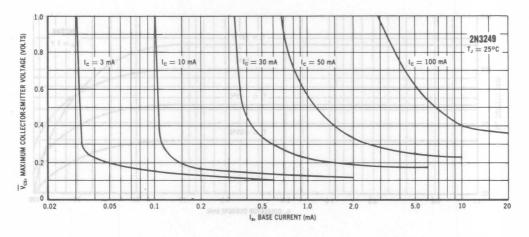


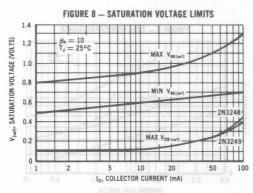


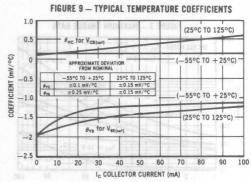


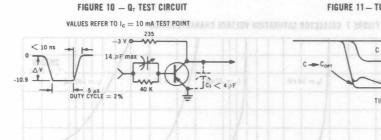
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

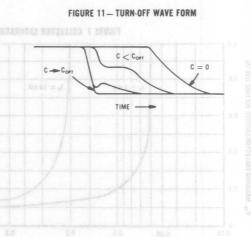
2143249











Rating	Symbol	2N3250 2N3251	2N3250A 2N3251A	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Base Voltage	Vсво	50	60	Vdc
Emitter-Base Voltage	VEBO	Aldset	21/3251 0.6	Vdc
Collector Current	lc	A080 200 00 00 00 00		mAdc
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	0.36 2.06		Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.2 6.9		Watts mW/°C
Operating and Storage Temperature Temperature Range	T _J , T _{stg}	- 65 to +200		°C

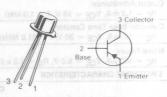
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.15	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.49	mW/°C

2N3250,A 2N3251,A

2N3250A,2N3251A JAN, JTX, JTXV AVAILABLE

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



GENERAL PURPOSE TRANSISTORS PNP SILICON

ELECTRICAL	CHARACTERISTICS	$(T_{\Delta} =$	25°C unless	otherwise	noted.)
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Characteristic		Symbol	Min	Max	Unit	
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (1) (I _C = 10 mAdc)		2N3250, 2N3251 2N3250A, 2N3251A	V(BR)CEO	40 60	-	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc$)	RACT	2N3250, 2N3251 2N3250A, 2N3251A	V(BR)CBO	50 60	-	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc)			V(BR)EBO	5.0	-	Vdc
Collector Cutoff Current (V _{CE} = 40 Vdc, V _{BE} = 3.0 Vdc)		3801	ICEX	U30 — 1	20	Adc
Base Cutoff Current (V _{CE} = 40 Vdc, V _{BE} = 3.0 Vdc)			IBL	HIT	50	nAdc
ON CHARACTERISTICS		3 65	= 4			
DC Forward Current Transfer Radio (1) (IC = 0.1 mAdc, VCE = 1.0 Vdc)	0	2N3250, 2N3250A 2N3251, 2N3251A	hFE	40 80	K	H es
(I _C = 1.0 mAdc, V_{CE} = 1.0 Vdc)		2N3250, 2N3250A 2N3251, 2N3251A		45 90	(X)	001
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$		2N3250, 2N3250A 2N3251, 2N3251A		50 100	150 300	
(I _C = 50 mAdc, V _{CE} = 1.0 Vdc)	- 03	2N3250, 2N3250A 2N3251, 2N3251A		15 30		
Collector-Emitter Saturation Voltage (1) (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)		V01 = 3	VCE(sat)		0.25 0.5	Vdc
Base-Emitter Saturation Voltage (1) (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)	05		VBE(sat)	0.6	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS		and the same of th	10			
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)		2N3250, 2N3250A 2N3251, 2N3251A	fT	250 300		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)			C _{obo}		6.0	pF
Input Capacitance (V _{CB} = 1.0 Vdc, I _C = 0, f = 100 kHz)		03	C _{ibo}	5 40 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	8.0	pF

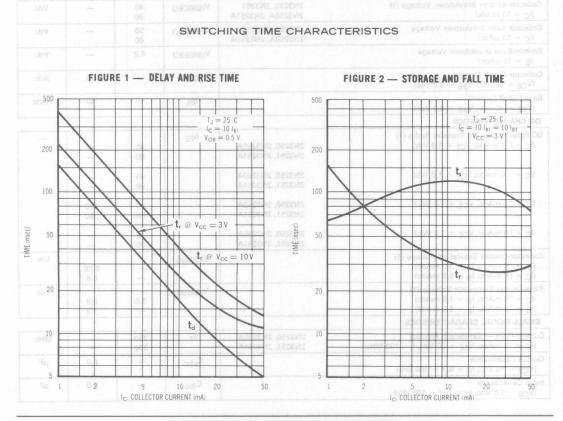
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Max	Unit
Input Impedance (I _C = 1.0 mA, V _{CE} = 10 V, f = 1.0 kHz)		2N3250, 2N3250A 2N3251, 2N3251A	h _{ie}	1.0 2.0	6.0 12	kohms
Voltage Feedback Ratio (I _C = 1.0 mA, V _{CE} = 10 V, f = 1.0 kHz)	Vdc	2N3250, 2N3250A 2N3251, 2N3251A	h _{re}		10 20	X 10-4
Small-Signal Current Gain (I _C = 1.0 mA, V _{CE} = 10 V, f = 1.0 kHz)	Vds	2N3250, 2N3250A 2N3251, 2N3251A	h _{fe}	50 100	200 400	ag-negtion:
Output Admittance (I _C = 1.0 mA, V _{CE} = 10 V, f = 1.0 kHz)	obAm tteW	2N3250, 2N3250A 2N3251, 2N3251A	d hoe	4.0	40 60	μmhos
Collector Base Time Constant (I _C = 10 mA, V _{CE} = 20 V, f = 31.8 MHz)	mW/ric Watte	2.66	rb'CC	- 0 Tc = 281C	250	ps all ps
Noise Figure (IC = 100 μ A, VCF = 5.0 V, Rs = 1.0 k Ω , f = 1	00 Hz)	0.8 0.00 + of 38 -	NF	Lemperature	6.0	dB

SWITCHING CHARACTERISTICS

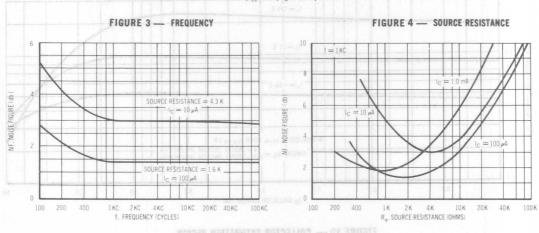
Characteristic			Symbol	Max	Unit	
Delay Time	(V _{CC} = 3.0 Vdc, V _{BE} = 0.5 Vdc	xelvi	Symbol	t _d	35	ns
Rise Time	10 - 0 - 10 - 10			t _r	35	ns
Storage Time MOO	$(I_C = 10 \text{ mAdc}, I_{B1} = I_{B2} = 1.0 \text{ mAdc})$ $V_{CC} = 3.0 \text{ V})$	0.49	2N3250, 2N3250A 2N3251, 2N3251A	umA ^t s nouse	175 200	ns
Fall Time				tf	50	ns

(1) Pulse Test: PW = 300 μ s, Duty Cycle = 2.0%.



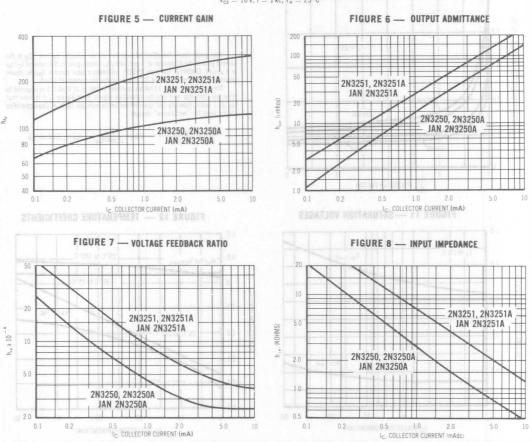
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





h PARAMETERS

 $V_{CE}=10\,V,\,f=1\,kc,\,T_A=25^\circ C$



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 9 - NORMALIZED CURRENT GAIN CHARACTERISTICS

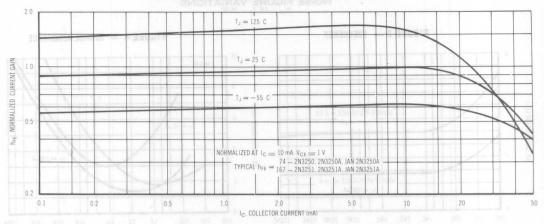
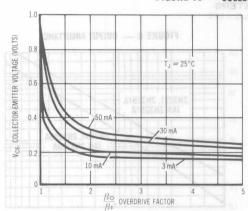


FIGURE 10 — COLLECTOR SATURATION REGION



This graph shows the effect of base current on collector current. $\beta_{\rm O}$ is the current gain of the transistor at 1 volt, and $\beta_{\rm F}$ (forced gain) is the ratio of $I_{\rm C}/I_{\rm BF}$ in a circuit. EXAMPLE: For type 2N3251, estimate a base current ($I_{\rm BF})$ to insure saturation at a temperature of 25 C and a collector current of 10mA. Observe that at $I_{\rm C}=10$ mA an overdrive factor of at least 2.5 is required to drive the transistor well into the saturation region. From Figure 1, it is seen that $h_{\rm FE}$ (\odot) volt is typically 167 (guaranteed limits from the Table of Characteristics can be used for "worst-case" design) . . .

$$\frac{\beta_{\rm O}}{\beta_{\rm F}} = \frac{h_{\rm F} @~1~{\rm Volt}}{I_{\rm C}/I_{\rm BF}} \qquad 2.5 = \frac{167}{10~{\rm mA/I_{BF}}} \qquad I_{\rm BF} \approx 6.68~{\rm mA~typ}$$

FIGURE 11 — SATURATION VOLTAGES

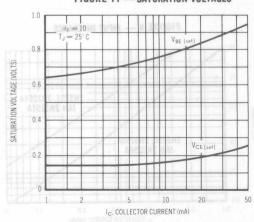
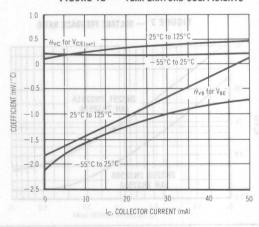
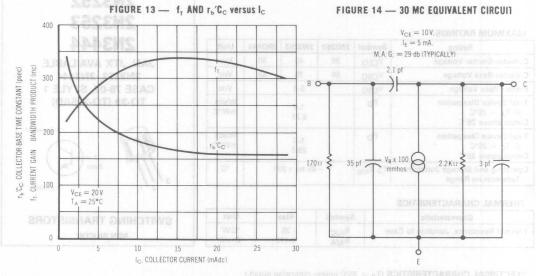
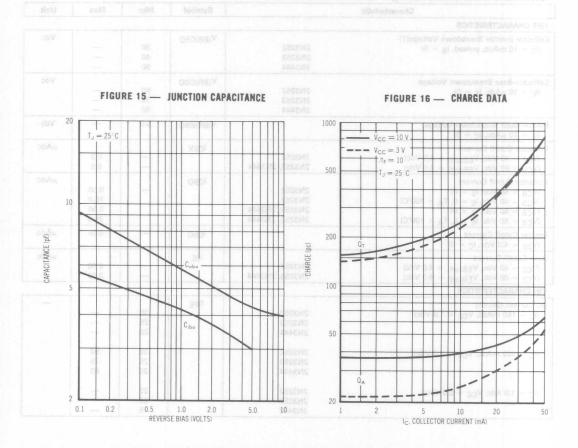


FIGURE 12 - TEMPERATURE COEFFICIENTS







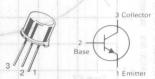


Rating	Symbol	2N3252	2N3253	2N3444	Unit
Collector-Emitter Voltage	VCEO	30	40	50	Vdc
Collector-Base Voltage	VCBO	60	75	80	Vdc
Emitter-Base Voltage	VEBO	7	5.0		Vdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1.0 5.71			Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C	

2N3252 2N3253 2N3444

f, Alie t, Co versus lo

JAN, JTX AVAILABLE 2N3253, 2N3444 **CASE 79-02, STYLE 1** TO-39 (TO-205AD)



SWITCHING TRANSISTORS NPN SILICON

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$ $R_{\theta JA}$	35 0.175	°C/W °C/mW

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, pulsed, IB = 0)	2N3252 2N3253 2N3444	V(BR)CEO	30 40 50	=	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	2N3252 2N3253 2N3444	V(BR)CBO	60 75 80	19913	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)] [[] [] []	V(BR)EBO	5.0	1 1	Vdc
Collector Cutoff Current (VCE = 40 Vdc, V _{EB(off)} = 4.0 Vdc) (VCE = 60 Vdc, V _{EB(off)} = 4.0 Vdc)	2N3252 2N3253, 2N3444	ICEX		0.5 0.5	μAdc
Collector Cutoff Current (VCB = 40 Vdc, IE = 0) (VCB = 40 Vdc, IE = 0, TA = 100°C) (VCB = 60 Vdc, IE = 0) (VCB = 60 Vdc, IE = 0, TA = 100°C)	2N3252 2N3252 2N3253, 2N3444 2N3253, 2N3444	ICBO		0.50 75.0 0.50 75.0	μAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, I _C = 0)		IEBO		0.05	μAdc
Base Cutoff Current (V _{CE} = 40 Vdc, V _{EB(off)} = 4.0 Vdc) (V _{CE} = 60 Vdc, V _{EB(off)} = 4.0 Vdc)	2N3252 2N3253, 2N3444	IBL		0.50 0.50	μAdc
ON CHARACTERISTICS					
DC Current Gain(1) (IC = 150 mAdc, VCE = 1.0 Vdc)	2N3252 2N3253 2N3444	hFE	30 25 20		-
(I _C = 500 mAdc, V _{CE} = 1.0 Vdc)	2N3252 2N3253 2N3444		30 25 20	90 75 60	
(I _C = 1.0 Adc, V _{CE} = 5.0 Vdc)	2N3252 2N3253 2N3444	1 1 1 11	25 20 15		

40

30

5.0

tf

ns

ns

nC

Characteristic		Symbol	Min	Max	Unit	
Collector-Emitter Satur (I _C = 150 mAdc, I _B		2N3252 2N3253, 2N3444	VCE(sat)	+	0.3 0.35	Vdc
$(I_C = 500 \text{ mAdc}, I_B)$	= 500 mAdc)	2N3252 2N3253, 2N3444		2 <u>m</u> 061 :=	0.5 0.60	
(I _C = 1.0 Adc, I _B =	100 mAdc)	2N3252 2N3253, 2N3444		=	1.0	
Base-Emitter Saturation (I _C = 150 mAdc, I _B (I _C = 500 mAdc, I _B (I _C = 1.0 Adc, I _B =	= 15 mAdc) = 50 mAdc)		VBE(sat)	0.7	1.0 1.3 1.8	Vdc
SMALL-SIGNAL CHA	RACTERISTICS					_ 14
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz) 2N3252 2N3253, 2N3444			a ffT a	200 175	2 3	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)			C _{obo}	_	12	pF
Input Capacitance ($V_{EB}=0.5\ Vdc,\ I_{C}=0,\ f=100\ kHz)$			C _{ibo}	_	80	pF
SWITCHING CHARAC	TERISTICS					
Delay Time	I _C = 500 mAdc, I _{B1} = 50 mAdc		td		15	ns
Rise Time	V _{CC} = 30 V, V _{BE} = 2.0 V	2N3252 2N3253, 2N3444	tr		30	ns

(I_C = 500 mAdc, I_{B1} = 50 mAdc, V_{CC} = 30 V) (1) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

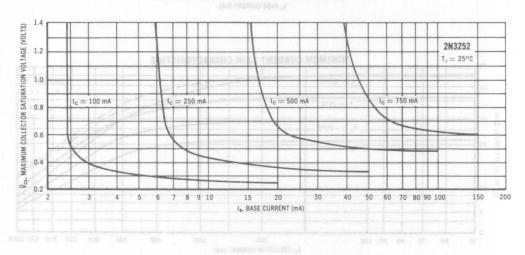
Storage Time

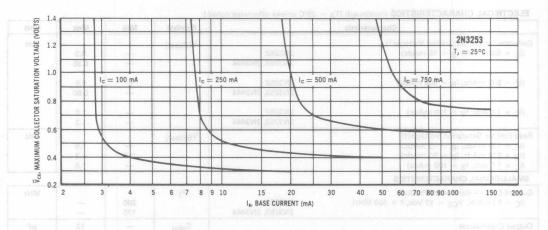
Total Control Charge

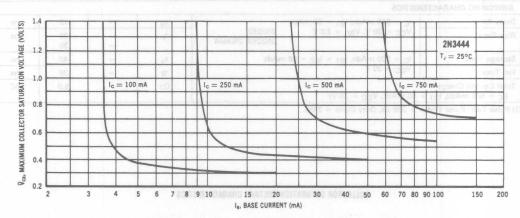
Fall Time

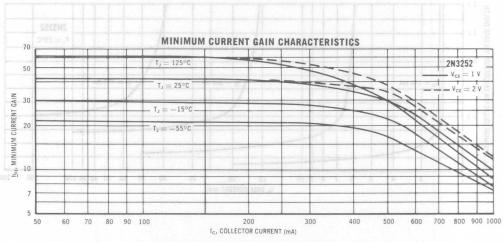
 $I_C = 500 \text{ mAdc}$, $I_{B1} = I_{B2} = 50 \text{ mAdc}$ $V_{CC} = 30 \text{ V}$

COLLECTOR SATURATION VOLTAGE CHARACTERISTICS

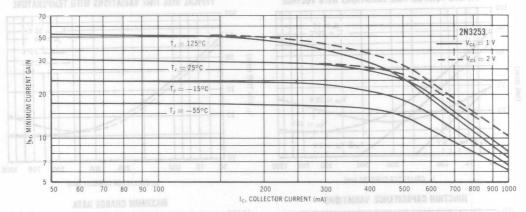


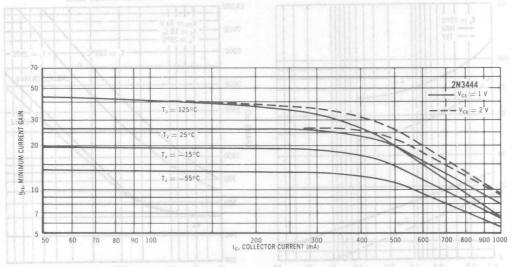


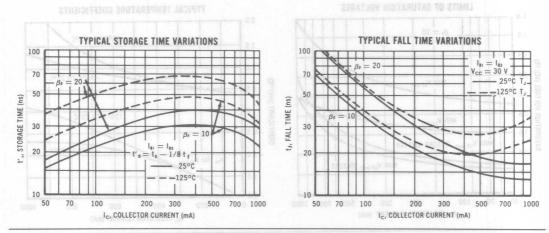




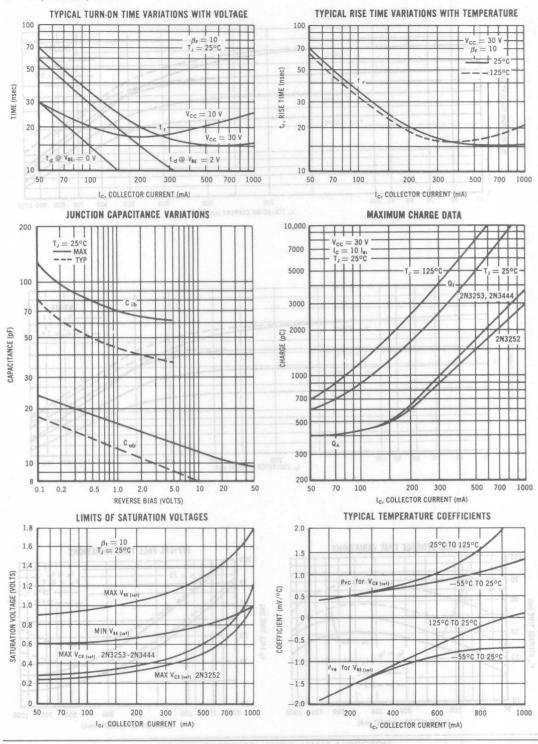
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS







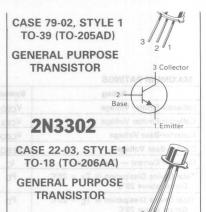
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



2N3308

MAXIMUM RATINGS

Rating	Symbol	Value		Unit	
Collector-Emitter Voltage (Applicable 0 to 10 mAdc)	VCEO	30 EMS V		Vdc	
Collector-Base Voltage	VCBO	bV 6	60	Vdc	
Emitter-Base Voltage	VEBO	5.08		Vdc	
Collector Current — Continuous	Ic	6V 500 0.8		mAdc	
semma i ammer	- 0	2N3300	2N3302		
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	0.8 4.56	0.36 2.06	Watt mW/°C	
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	3.0 17.2	1.8	Watts mW/°C	
Operating and Storage Junction Temperature Range			+ 200	°C	



Refer to 2N2218 for graphs.

NPN SILICON

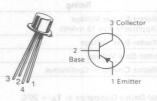
sinU xall Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			CTEMBTICS	ARAHO TO
Collector-Emitter Sustaining Voltage(1) (IC = 10 mAdc, IB = 0)	V _{CEO(sus)}	30	itter Br eaktr	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		60	mAde_Ig = I	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		5.0	Advert Description	Vdc
Collector Cutoff Current $(V_{CE} = 50 \text{ Vdc}, V_{BE} = 0)$ $(V_{CE} = 50 \text{ Vdc}, V_{BE} = 0, T_A = 150^{\circ}\text{C})$	ICES	_ (0	0.01	μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	IEBO	(Plag ul loV n	vota (10 8 sa	nAdc
Base Current (V _{CE} = 50 Vdc, V _{BE} = 0)		_	0 = 10 ODA	nAdc
ON CHARACTERISTICS				
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 10 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)(1) 2N3300, 2N3302 2N3300, 2N3302	hFE	35 50 75	Ade. ic = 0 soft Current Vdc)_	
(IC = 150 mAdc, VCE = 1.0 Vdc)(1) 2N3300, 2N3302 (IC = 150 mAdc, VCE = 10 Vdc)(1) 2N3300, 2N3302 (IC = 500 mAdc, VCE = 10 Vdc)(1) 2N3300, 2N3302		50 100 50	300 HO	VCB = 1
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	VCE(sat)	(a mAda)	0.22 0.45 0.6	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	V _{BE(sat)}).6 mAdq Voltage	1.3 1.5	0.6 Vdc)
Base Emitter Voltage (I _C = 150 mA, V _{CE} = 10 V)		aor as aar	1.1 V	Max
SMALL-SIGNAL CHARACTERISTICS		In Product	hisanas II a	deFlatnam
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	s) fp1 00 f	250	Vac . I c = 1	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 140 kHz)		Oper ati on	8.0	pF.
Input Capacitance (VBE = 2.0 Vdc, I _C = 0, f = 140 kHz)		(bliam 0.	20	pF
SWITCHING CHARACTERISTICS		MARK NO. 1	scitance	de Cabi
Turn-On Time ($V_{CC} = 25 \text{ Vdc}$, $I_{C} = 300 \text{ mAdc}$, $I_{B1} = 30 \text{ mAdc}$)	ton	- 1 y	60	ns
Turn-Off Time $(V_{CC} = 25 \text{ Vdc}, I_{C} = 300 \text{ mAdc}, I_{B1} = I_{B2} = 30 \text{ mAdc})$	toff	_ n	150	ns
1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.				(VCE = 3)



Rating	Symbol	2N3307	2N3308	Unit
Collector-Emitter Voltage	VCEO	35	25	Vdc
Collector-Emitter Voltage	VCES	40	30	Vdc
Collector-Base Voltage	VCBO	40	30	Vdc
Emitter-Base Voltage	VEBO	pbAm 3	3.0 008	Vdc
Collector Current — Continuous	Ic	2	50 8/48 01	mAdc
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD PD		.14 §	mW mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD		.71	mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	⊃−65 t	0 +200	o oC €

2N3307 2N3308

CASE 20-03, STYLE 10 TO-72 (TO-206AF)



GENERAL PURPOSE TRANSISTORS

PNP SILICON

ELECTRICAL	CHARACI	ERISTICS	$(T_A =$	25°C unle	ss otherwise	noted.)

tind. xalli mile Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage $(I_{C_i} = 2.0 \text{ mAdc}, I_{B_i} = 0)$	VCEO(sus) V(BR)CRO	2N3307 2N3308	V(BR)CEO	35 25	sitter Sudditte sz Br <u>eakdown</u>	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu Adc, V_{BE} = 0$)	Verniero Ices	2N3307 2N3308	V(BR)CES	40 30	/ mwobles-s s	Vdc
Collector-Base Breakdown Voltage(1) (I _C = 10 μ Adc, I _E = 0)	083 ¹	2N3307 2N3308	V(BR)CBO	40 30	A 1001 H	□ Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	garl		V(BR)EBO	3.0	Ga:s	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc) (V _{CB} = 15 Vdc, T = 150°C)		2N3307	Ісво	10 Vdal 10 Vdal 10 Vdal(1)	0.010 3.0	μAdc
ON CHARACTERISTICS						150 = 150
DC Current Gain (VCE = 10 Vdc, IC = 2.0 mAdc)	VCE(sat)	2N3307 2N3308 2N 2N 2N 2N 2N 2N 2N 2N 2N 2N 2N 2N 2N		40 25	250 250	is-notaello
Collector-Emitter Saturation Voltage (IC = 3.0 mAdc, IB = 0.6 mAdc)	DeciseV	Je, 1g = 50 mAde) de, 1g = 15 mAde)	VCE(sat)	agesto	0.4 V consums?	- Vdc
Base-Emitter Saturation Voltage (IC = 3.0 mAdc, IB = 0.6 mAdc		Je, Ig = 30 mAdo). Je, Ig = 60 mAdo)	VBE(sat)		1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	(no)38V		W 01 - 33V.	Am Der -	Do abenon	WHALE PAR
Current-Gain — Bandwidth Product (VCE = 10 Vdc, I _C = 2.0 mAdc, f =	100 MHz	VCE = 10 Vdc. f = 100 MHz)	opAmr08 = 3l)	300	1200	MHz
Maximum Frequency of Operation (VCE = 10 Vdc, IC = 2.0 mAdc)	Ceba	\$ KH2 0	fmax		pical 2000	MHz
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 0.1 \text{ MH})$	z not	2N3307 2N3308	Cobo	smes s Wab Ig =	1.3	ov se pF
Small-Signal Current Gain $(V_{CE} = 10 \text{ Vdc}, I_{C} = 2.0 \text{ mAdc}, f =$	1 kHz)	2N3307 2N3308	h _{fe}	40 25	250 250	en <u>s O</u> st Tis Pulse Tes
Collector Base Time Constant $(V_{CB} = 10 \text{ Vdc}, I_{C} = 2.0 \text{ mAdc}, f =$	31.8 MHz)	2N3307 2N3308	rb′C _C	2.0	15 20	ps

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

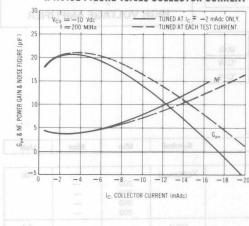
Characteristic	38V	250	350	005	Symbol	Min	Max	Unit
Noise Figure				980	NF	osoV	agasloV sea	dB
(V _{CE} = 10 Vdc, I _C = 2.0 mAdc, f = 200 MHz)		2N3307 2N3308		0.0		083	4.5 6.0	
SWITCHING CHARACTERISTICS	300A			A CONTRACTOR OF THE PARTY OF TH			- Singer	O soto elle?
Power Gain(2) (V _{CE} = 10 Vdc, I _C = 2.0 mAdc, f = 200 MHz)	SUA				Ge	17	- animologia	ouridB 3
Power Gain (AGC)(2) (V _{CE} = 5.0 Vdc, I _C = 20 mAdc, f = 200 MHz)	Watte	2N3307			Ge	-	OVE 2010	(aBb _A =)
		2N3308				_	_	

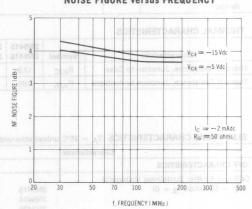
(1) Cobo is measured in guarded circuit such that the can capacitance is not included.

(2) AGC is obtained by increasing I_C. The circuit remains adjusted for $V_{CE} = -10$ Vdc, $I_{C} = -2$ mAdc operation.

COMMON EMITTER AVERAGE SMALL POWER GAIN & NOISE FIGURE versus COLLECTOR CURRENT

NOISE FIGURE versus FREQUENCY











		Pi	NP	NPN		
Rating	Symbol	2N5415	2N5416	2N3439	2N3440	Unit
Collector-Emitter Voltage	VCEO	200	300	350	250	Vdc
Collector-Base Voltage	VCBO	200	350	450	300	Vdc
Emitter-Base Voltage	VEBO	4.0	6.0	7.0	7.0	Vdc
Base Current	IB		0	.5	0000413	Adc
Collector Current — Continuous	IC	1.0				Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	gÐ.		1 5	.0 .7	Watts mW/°0
Total Device Dissipation (a T _C = 25°C Derate above 25°C	P _D		0 sheb		3.6	Watts mW/°0
Total Device Dissipation (ii T _A = 50°C Derate above 50°C	PD		.0			Watts mW/°0
Operating and Storage Junction Temperature Range	TJ, T _{stg}	17 32101		0 +200	Min	°C

NPN 2N3439 2N3440

PNP 2N5415 2N5416





JAN, JTX, JTXV AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)



HIGH VOLTAGE AMPLIFIER

THERMAL CHARACTERISTICS

Characteristic	Symbol	2N5415 2N5416	2N3439 2N3440	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	17.5	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	150	175	°C/W

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteris	stic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage(1) (IC = 50 mAdc, IB = 0)	2N5415 2N5416 2N3439 2N3440	VCEO(sus)	200 300 350 250	- 1	Vdc
*Collector Cutoff Current (V _{CE} = 300 Vdc, I _B = 0) (V _{CE} = 200 Vdc, I _B = 0)	2N3439 2N3440	ICEO	=	20 50	μAdc
*Collector Cutoff Current (V _{CE} = 450 Vdc, V _{BE} = 1.5 Vdc) (V _{CE} = 300 Vdc, V _{BE} = 1.5 Vdc)	2N3439 2N3440	ICEX	_	500 500	μAdo
Collector Cutoff Current (V _{CB} = 175 Vdc, I _E = 0) (V _{CB} = 280 Vdc, I _E = 0) (V _{CB} = 360 Vdc, I _E = 0) (V _{CB} = 250 Vdc, I _E = 0)	2N5415 2N5416 2N3439 2N3440	СВО	=	50 50 20 20	μAdd
Emitter Cutoff Current (VEB = 4.0 Vdc, IC = 0) (VEB = 6.0 Vdc, IC = 0)	2N5415 2N5416, 2N3439, 2N3440	IEBO	=	20 20	μAdc
ON CHARACTERISTICS(1)					
DC Current Gain (I _C = 2.0 mAdc, V_{CE} = 10 Vdc) *(I _C = 20 mAdc, V_{CE} = 10 Vdc)	2N3439 2N3439, 2N3440	hFE	30 40	— 160	
*($I_C = 50 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$)	2N5415 2N5416		30 30	150 120	
Collector-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 4.0 mAdc)	2N3439, 2N3440	V _{CE(sat)}	-	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 4.0 mAdc)	2N3439, 2N3440	V _{BE(sat)}	-	1.3	Vdc

*Indicates Data in Addition to JEDEC Requirements.

2N3439, 2N3440 NPN / 2N5415, 2N5416 PNP

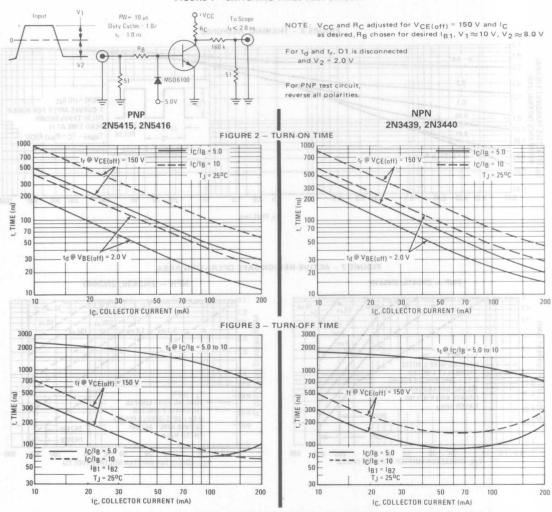
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (IC = 10 mAdc, VCF = 10 Vdc, f = 5.0 MHz) 2N3439, 2N3440	fr	15	V <u>cc</u> =18 V	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz) 2N5415, 2N5416, 2N3439, 2N3440	C _{obo}	1	15 10	pF
Input Capacitance (VEB = 5.0 Vdc, I _C = 0, f = 1.0 MHz)	Cibo		75	pF
Small-Signal Current Gain (IC = 5.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz) (IC = 10.0 mAdc, V _{CE} = 10 Vdc, f = 5.0 MHz) 2N5415, 2N5416	h _{fe}	25		
Real Part of Input Impedance $(V_{CE} = 10 \text{ Vdc}, I_{C} = 5.0 \text{ mAdc}, f = 1.0 \text{ MHz})$	Re(h _{ie})	1	300	Ohms

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

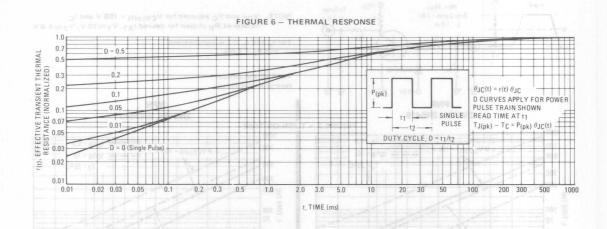
CAUTION: The sustaining voltage *must not* be measured on a curve tracer. (See Fig. 15.)

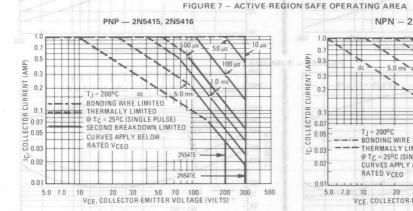
FIGURE 1 - SWITCHING TIMES TEST CIRCUIT

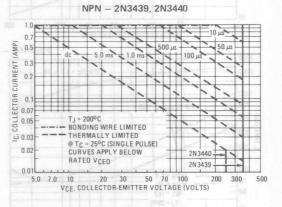


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 4 - CURRENT-GAIN - BANDWIDTH PRODUCT 100 70 (Hd) 50 ACITANCE 20 10 7.0 - PNP (MJ5415, MJ5416) 5.0 --- NPN (2N3439, 2N3440) 0.2 0.5 1.0 2.0 5.0 10 20 50 100 is a do ballicaem VR, REVERSE VOLTAGE (VOLTS) as add (MOTU)

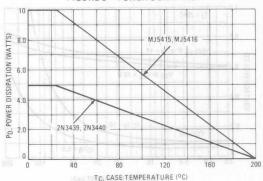






MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





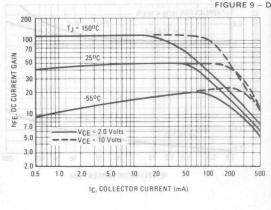
There are two limitations on the power handling ability of a transistor, average junction temperature and second breakdown. Safe operating area curves indicate IC-VCE limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate

not be subjected to greater dissipation than the curves indicate. The data of Figure 7 is based on $T_{J(pk)}=200^{\circ}C$; T_{C} is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200^{\circ}C$. $T_{J(pk)}$ may be calculated from the data in Figure 6. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. (See AN-415).

PNP 2N5415, 2N5416

NPN 2N3439 2N3440





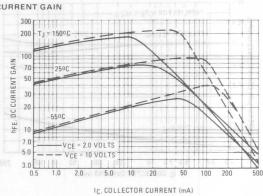
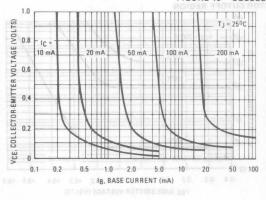
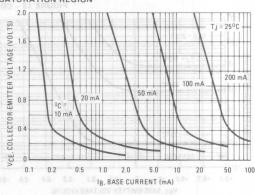
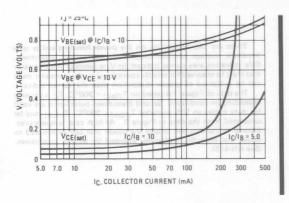


FIGURE 10 - COLLECTOR SATURATION REGION







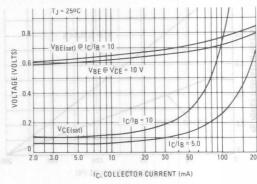
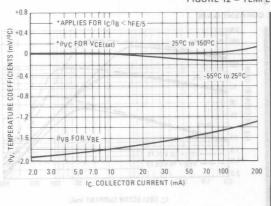


FIGURE 12 - TEMPERATURE COEFFICIENTS



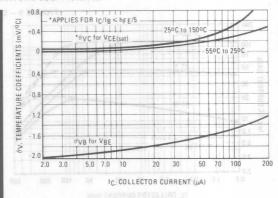


FIGURE 13 – COLLE

105

104

104

TJ = 150°C

100°C

100°C

100°C

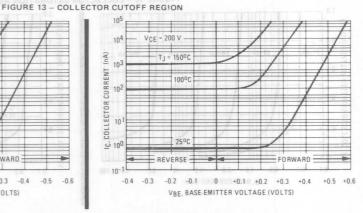
REVERSE

FORWARD

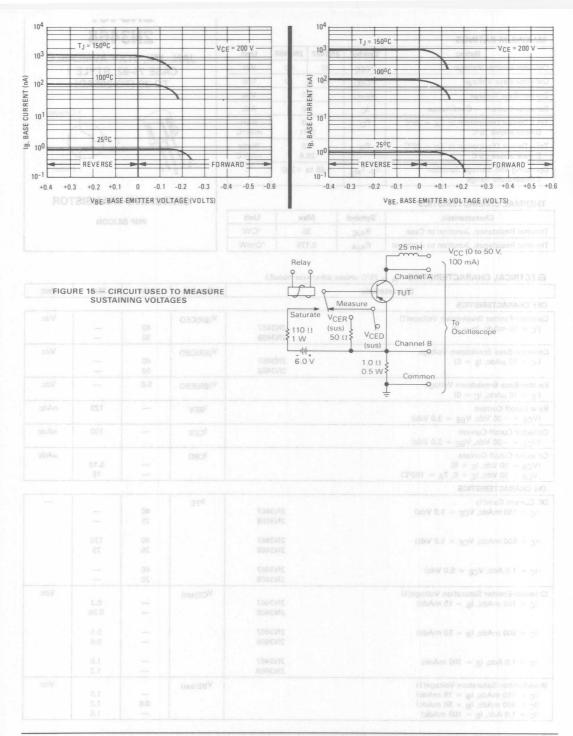
10-1

+0.4 +0.3 +0.2 +0.1 0 -0.1 -0.2 -0.3 -0.4 -0.5 -0.6

VBE, BASE-EMITTER VOLTAGE (VOLTS)



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



MAXIMUM RATINGS Symbol 2N3467 2N3468 Unit Rating Collector-Emitter Voltage VCEO 50 Vdc Collector-Base Voltage 40 50 Vdc VCBO Emitter-Base Voltage VEBO 5.0 Vdc 1.0 Adc Collector Current — Continuous IC Total Device Dissipation (α T_A = 25°C PD 1.0 Watt Derate above 25°C 5.71 mW/°C Total Device Dissipation (a T_C = 25°C 5.0 Watts PD Derate above 25°C 28.6 mW/°C

2N3467 2N3468

JAN, JTX, JTXV AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)



°C

-65 to +200

2N3440 NPN / 2N5415, 2N5476 PMP



SWITCHING TRANSISTOR

PNP SILICON

THERMAL CHARACTERISTICS

Operating and Storage Junction

Temperature Range

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.175	°C/mW

TJ, Tstg

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

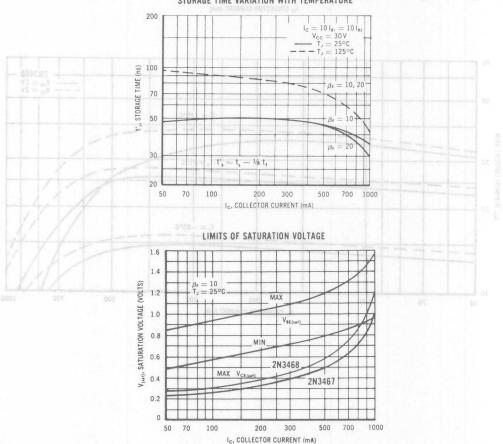
Chara	cteristic	Symbol		Max Max	Unit
OFF CHARACTERISTICS	Medisure	\$30		MIATZUZ	
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	2 1 (2004) 4 (21) 2N3467	V(BR)CEO	40 50		Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	2N3467 2N3468	V(BR)CBO	40 50	=	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	1	V(BR)EBO	5.0		Vdc
Base Cutoff Current $(V_{CE} = -30 \text{ Vdc}, V_{BE} = 3.0 \text{ Vdc})$		IBEV	_	120	nAdc
Collector Cutoff Current (V _{CE} = -30 Vdc, V _{BE} = 3.0 Vdc)		ICEX	_	100	nAdo
Collector Cutoff Current $(V_{CB} = 30 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 30 \text{ Vdc}, I_E = 0, T_A = 100^{\circ}\text{C})$		ІСВО	_	0.10 15	μAdc
ON CHARACTERISTICS					
DC Current Gain(1) $(I_C = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N3467 2N3468	hFE	40 25	=	-
$(I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	2N3467 2N3468		40 25	120 75	
$(I_C = 1.0 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc})$	2N3467 2N3468		40 20		
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	2N3467 2N3468	VCE(sat)	Ξ	0.3 0.36	Vdc
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$	2N3467 2N3468		=	0.5 0.6	
$(I_C = 1.0 \text{ Adc}, I_B = 100 \text{ mAdc})$	2N3467 2N3468		=	1.0 1.2	
Base-Emitter Saturation Voltage(1) (IC = 150 mAdc, IB = 15 mAdc) (IC = 500 mAdc, IB = 50 mAdc) (IC = 1.0 Adc, IB = 100 mAdc)		VBE(sat)	0.8	1.0 1.2 1.6	Vdc

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

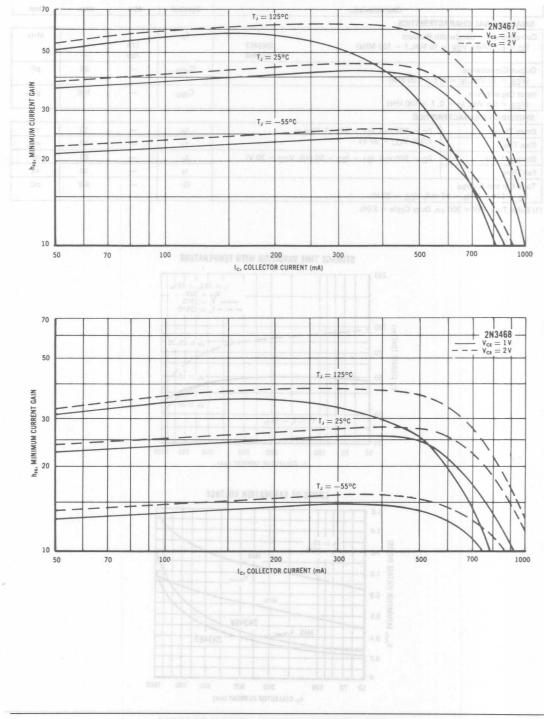
Characteristic			Symbol	Min	Max	Unit
SMALL-SIGNAL CHA	RACTERISTICS	0,024 70.54				
Current-Gain — Band (I _C = 50 mAdc, V _C	width Product E = 10 Vdc, f = 100 MHz)	2N3467 2N3468	fT	175 150		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)			C _{obo}	<u> </u>	25	pF
Input Capacitance (VEB = 0.5 Vdc, IC = 0, f = 100 kHz)			C _{ibo}	-	100	pF
SWITCHING CHARAC	CTERISTICS	0022				7 00 1
Delay Time	$(I_C = 500 \text{ mA}, I_{B1} = 50 \text{ mA}, V_{BE})$	=	t _d		10	ns
Rise Time	2.0 V, V _{CC} = 30 V)		t _r	+	30	ns
Storage Time	$(I_C = 500 \text{ mA}, I_{B1} = I_{B2} = 50 \text{ mA}, V_{CC} = 30 \text{ V})$		t _S		60	ns
Fall Time		tf		30	ns	
Total Control Charge (I _C = 500 mA, I _B = 50 mA, V _{CC} = 30 V)		От		6.0	nC	

(1) Pulse Test: PW \leq 300 μ s, Duty Cycle \leq 2.0%.

STORAGE TIME VARIATION WITH TEMPERATURE



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



MAXIMUM RATINGS	adl I			
Rating	Symbol	2N3494 2N3496	2N3495 2N3497	Unit
Collector-Emitter Voltage	VCEO	80	120	Vdc
Collector-Base Voltage	VCBO	80	120	Vdc
Emitter-Base Voltage	VEBO	4	.5	Vdc
Collector Current — Continuous	Ic	10	00	mAdc
		2N3494 2N3495	2N3496 2N3497	
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	600 3.43	400 2.28	mW mW/°C
Total Device Dissipation (a T _C = 25°C* Derate above 25°C	PD	3.0 17.2	1.2 6.85	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	0 +200	inu of cata

^{*}Indicates Data in addition to JEDEC Requirements.



CASE 79-02, STYLE 1 TO-39 (TO-205AD)



2N3496 2N3497

CASE 22-03, STYLE 1 TO-18 (TO-206AA)

GENERAL PURPOSE
TRANSISTOR
PNP SILICON



Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		11 (1 / .
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	2N3494, 2N3496 2N3495, 2N3497	V(BR)CEO	80 120	-100	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	2N3494, 2N3496 2N3495, 2N3497	V(BR)CBO	80 120	EZOT	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	THE STATE	V _{(BR)EBO}	4.5	T porter	Vdc
Collector Cutoff Current (VCB = 50 Vdc, I _E = 0) (VCB = 90 Vdc, I _E = 0)	2N3494, 2N3496 2N3495, 2N3497	ICBO		100 100	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)	The season of th	IEBO		25	nAdd
ON CHARACTERISTICS		La R. H.			1
DC Current Gain(1) (I _C = 100 μAdc, V _{CE} = 10 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 50 mAdc, V _{CE} = 10 Vdc) (I _C = 100 mAdc, V _{CE} = 10 Vdc)	2N3494, 2N3496	hFE	35 40 40 40 40 35	H	0
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc)	2N3494, 2N3496 2N3495, 2N3497	VCE(sat)	RETURNED NOT	0.3 0.35	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		VBE(sat)	0.6	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	11 80-3 11111				
Current-Gain — Bandwidth Product(2) (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	2N3494, 2N3496 2N3495, 2N3497	fT	200 150	_	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	2N3494, 2N3496 2N3495, 2N3497	C _{obo}		7.0 6.0	pF
Input Capacitance (VBE = 2.0 Vdc, IC = 0, f = 100 kHz)	1 E E	Cibo	Joseph Al	30	pF

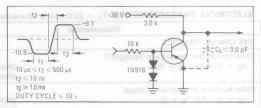
Characteristic				Symbol	Min	Max	Unit
Input Impedance (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)				hie	0.1	1.2	k ohms
Voltage Feedback Ratio (I _C = 10 mAdc, V _{CF} = 10 Vdc, f = 1.0 kHz)		PARAGIAS	SHEADS	h _{re}		2.0	X 10-4
Small-Signal Current Gain	tinU	2593497	3065345	h _{fe}	40	300	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	pb/	120	68	VCEO		spatteV nstr	offector-Emi
Output Admittance (IC = 10 mAdc, VCF = 10 Vdc, f = 1.0 kHz)				os hoe	-	300	μmhos
Real Part of Input Impedance (IC = 20 mAdc, VCE = 10 Vdc, f = 300 MHz)	Vete	0	01	Re(hie)	auoui	30_103	Ohms
SWITCHING CHARACTERISTICS		DESERTS.	SENEURS DENEURS				
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = 1.0 \text{ mAdc})$		400	600	ton	TA = Zerc	300	ns lete
Turn-Off Time (AA303-07) 87-07				toff		1000	ns

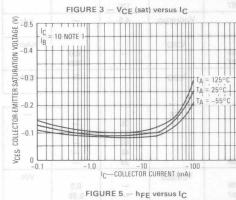
(V_{CC} = 30 Vdc, I_C = 10 mAdc, I_{B1} = I_{B2} = 1.0 mAdc) (1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle = 2.0%.

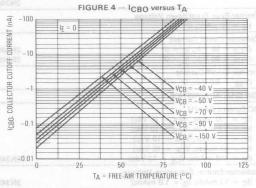
(2) fT is defined as the frequency at which |hfe| extrapolates to unity.

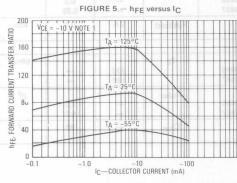
FIGURE 1 - TURN-ON TIME TEST CIRCUIT

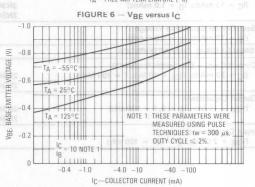
FIGURE 2 - TURN-OFF TIME TEST CIRCUIT





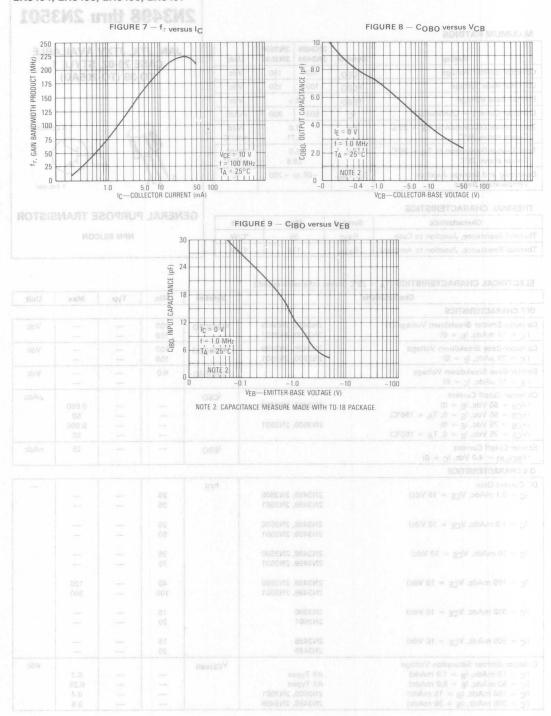






MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

2N3494, 2N3495, 2N3496, 2N3497



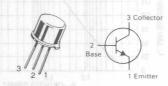
Rating	Symbol	2N3498 2N3499	2N3500 2N3501	Unit
Collector-Emitter Voltage	VCEO	100	150	Vdc
Collector-Base Voltage	Vсво	100	150	Vdc
Emitter-Base Voltage	VEBO	6	.0	Vdc
Collector Current — Continuous	Ic	500	300	mAdc
Total Device Dissipation (a, T _A = 25°C Derate above 25°C	PD	1.0 5.71		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	+ 200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	175	°C/W

2N3498 thru 2N3501

JAN, JTX, JTXV AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (1) (IC = 10 mAdc, IB = 0)	2N3498, 2N3499 2N3500, 2N3501	V(BR)CEO	100 150	=	_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	2N3498, 2N3499 2N3500, 2N3501	V(BR)CBO	100 150	=		Vdc
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$		V(BR)EBO	6.0	=	=	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 150°C) (V _{CB} = 75 Vdc, I _E = 0) (V _{CB} = 75 Vdc, I _E = 0, T _A = 150°C)	2N3498, 2N3499 2N3500, 2N3501	ICBO	=		0.050 50 0.050 50	μAdo
Emitter Cutoff Current (VBE(off) = 4.0 Vdc, I _C = 0)		IEBO	-		25	nAdd
ON CHARACTERISTICS						
DC Current Gain ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$)	2N3498, 2N3500 2N3499, 2N3501	hFE	20 35	=	_	_
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3498, 2N3500 2N3499, 2N3501		25 50	Ξ	=	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3498, 2N3500 2N3499, 2N3501		35 75	_	=	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3498, 2N3500 2N3499, 2N3501		40 100	_	120 300	
$(I_C = 300 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3500 2N3501		15 20		=	
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N3498 2N3499		15 20	=	=	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)	All Types All Types 2N3500, 2N3501 2N3498, 2N3499	VCE(sat)	=	=	0.2 0.25 0.4 0.6	Vdc

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)	All Types All Types 2N3500, 2N3501 2N3498, 2N3499	VBE(sat)		=	0.8 0.9 1.2 1.4	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(2) (VCE = 20 Vdc, IC = 20 mAdc, f = 100 MHz)		fT	150	-		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	2N3498, 2N3499 2N3500, 2N3501	C _{obo}	-	=	10 8.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)		C _{ibo}		-	80	pF
Input Impedance (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	2N3498, 2N3500 2N3499, 2N3501	h _{ie}	0.2 0.25	=	1.0 1.25	k ohms
Voltage Feedback Ratio (IC = 10 mAdc, VCE = 10 Vdc, f = 1.0 kHz)	2N3498, 2N3500 2N3499, 2N3501	h _{re}	12-	15= 1	2.5 4.0	X 10-4
Small-Signal Current Gain (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	2N3498, 2N3500 2N3499, 2N3501	h _{fe}	50 75	Ξ	300 375	_
Output Admittance (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	2N3498, 2N3500 2N3499, 2N3501	h _{oe}	OUR ST BUT	_ _ \$ _ \$ RU6	100	μmhos
SWITCHING CHARACTERISTICS						
Delay Time (I _C = 150 mAdc, I _{B1} = 15 mAdc, V _{CC} = 100 Vd	c, V _{BE(off)} = 2.0 Vdc)	td	-	20		ns
Rise Time (I _C = 150 mAdc, I _{B1} = 15 mAdc, V _{CC} = 100 Vd	c, V _{BE(off)} = 2.0 Vdc)	t _r		35		ns
Storage Time (I _C = 150 mAdc, I _{B1} = I _{B2} = 15 mAdc, V _{CC} =	100 Vdc)	t _S		800		ns
				T Daniel		

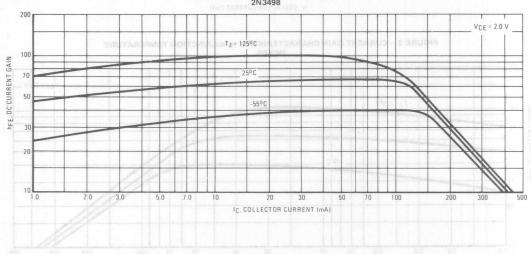
Fall Time (IC = 150 mAdc, IB1 = IB2 = 15 mAdc, VCC = 100 Vdc) (1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

FIGURE 1 — CURRENT GAIN CHARACTERISTICS versus JUNCTION TEMPERATURE 2N3498

tf

80

ns



⁽²⁾ $f_T = |h_{fe}| \cdot f_{test}$



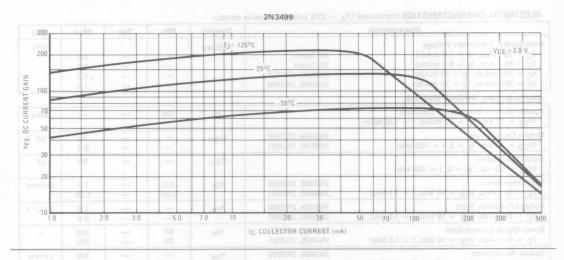
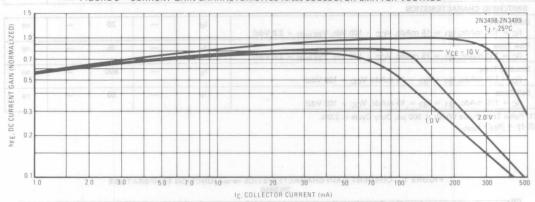
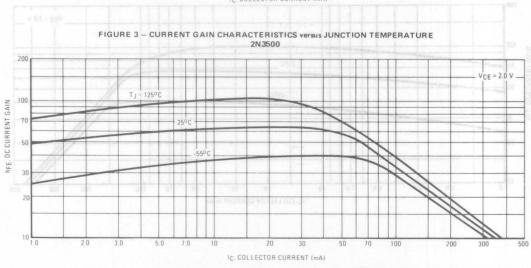


FIGURE 2 - CURRENT GAIN CHARACTERISTICS versus COLLECTOR-EMITTER VOLTAGE



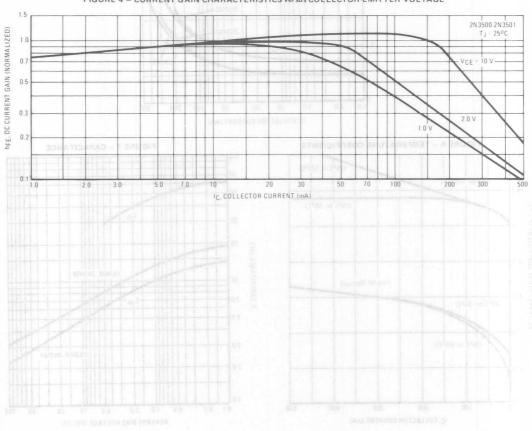


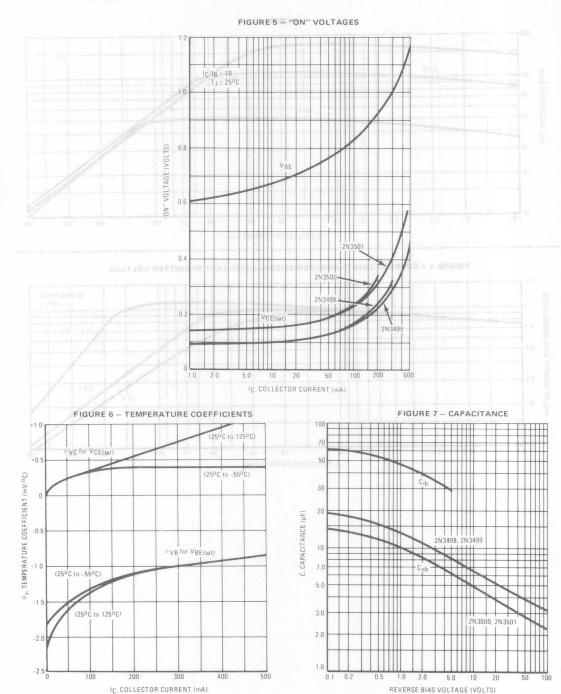
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





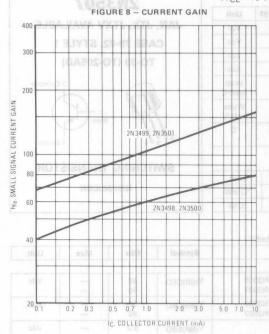
FIGURE 4 - CURRENT GAIN CHARACTERISTICS versus COLLECTOR-EMITTER VOLTAGE

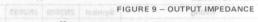






(V_{CE} = 10 Vdc, T_A = 25°C, f = 1.0 kHz)





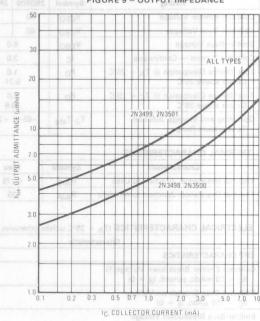


FIGURE 10 - INPUT IMPEDANCE

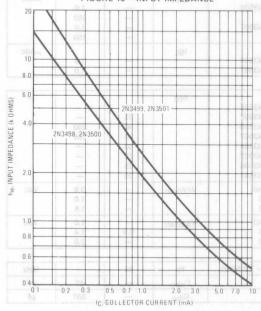
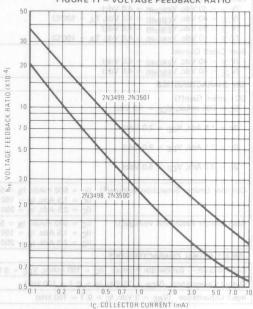


FIGURE 11 - VOLTAGE FEEDBACK RATIO



MAXIMUM KATINGS				
SDMAGS Rating TUO - 8 BRU	Symbol	2N3506	2N3507	Unit
Collector-Emitter Voltage	VCEO	40	50	Vdc
Collector-Base Voltage	VCBO	60	80	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	3	.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.71		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C

AUDIO SMALL SIGNAL 1. PARAMETER CHARACTERISTICS

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.175	°C/mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	35	°C/W

2N3506 2N3507

JAN, JTX, JTXV AVAILABLE

CASE 79-02, STYLE 1

TO-39 (TO-205AD)





SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, pulsed, I _B = 0)		2N3506 2N3507	V(BR)CEO	40 50		Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	ER 30 10	2N3506 2N3507	V(BR)CBO	60 80	0.2 0.3	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)			V(BR)EBO	5.0	T	Vdc
Collector Cutoff Current (VCE = 40 Vdc, VEB(off) = 4.0 Vdc) (VCE = 40 Vdc, VEB(off) = 4.0 Vdc, TVCE = 60 Vdc, VEB(off) = 4.0 Vdc, VCE = 60 Vdc, VEB(off) = 4.0 Vdc, TVCE = 60 Vdc, TVCE = 60 Vd	A = 100°C)	2N3506 2N3507	ICEX	NW1 - 01 3	1.0 150 1.0 150	μAdc
Base Cutoff Current (VCE = 40 Vdc, VEB(off) = 4.0 Vdc) (VCE = 60 Vdc, VEB(off) = 4.0 Vdc)	Jox .	2N3506 2N3507	IBL		1.0	μAdc
ON CHARACTERISTICS						
DC Current Gain(1) (IC = 500 mAdc, V_{CE} = 1.0 Vdc) (IC = 1.5 Adc, V_{CE} = 2.0 Vdc) (IC = 2.5 Adc, V_{CE} = 3.0 Vdc) (IC = 3.0 Adc, V_{CE} = 5.0 Vdc)	01 80	2N3506 2N3507 2N3506 2N3507 2N3506 2N3507 2N3506 2N3507	hFE (Cata	50 35 40 30 30 25 25 25	200 150	0.5
Collector-Emitter Saturation Voltage(1)	(I _C = 500 mAdc, I _B = (I _C = 1.5 Adc, I _B = 15 (I _C = 2.5 Adc, I _B = 25	0 mAdc) .	VCE(sat)		0.5 1.0 1.5	Vdc
Base-Emitter Saturation Voltage(1)	(I _C = 500 mAdc, I _B = (I _C = 1.5 Adc, I _B = 15 (I _C = 2.5 Adc, I _B = 25	0 mAdc)	V _{BE} (sat)	0.9	1.0 1.4 2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (Id	c = 100 mAdc, VCE = 5	Vdc, f = 20 MHz)	fT	60		MHz
Output Capacitance (VCB = 10 Vdc, Ig	= 0, f = 100 kHz)	MILL	Cobo	11411	40	pF
Input Capacitance (VBE = 3 Vdc, IC =	0, f = 100 kHz)	113 113 113	Cibo	10 13 - E	300	pF

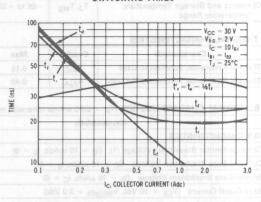
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

	Characteristic		Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS				RATINGS	MUNIXANA	
Delay Time	I _C = 1.5 Adc, I _{B1} = 150 mAdc	'dalue :	the etd	_	15	ns
Rise Time	V _{CC} = 30 V, V _{EB} = 0 V		papy t _r	-	30	ns
Storage Time	I _C = 1.5 Adc, I _{B1} = I _{B2} = 150 mAdc	15	pgpV t _s		99 55 V eq	ns
Fall Time	VCC = 30 V		ges t _f	_	35	ns

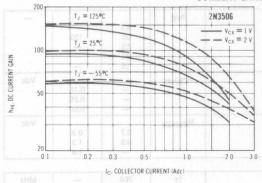
(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle = 2.0%.

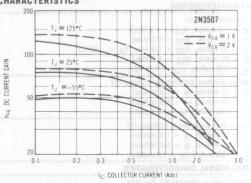


1.4 \$\begin{align*} \begin{align*}
SWITCHING TIMES



CURRENT GAIN CHARACTERISTICS





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

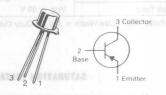
IVIAAIIVIOIVI NATIIVGS			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage —	VCEO	12	Vdc
Collector-Base Voltage	VCBO	15	Vdc
Emitter-Base Voltage	V _{EBO}	4.5	Vdc
DC Collector Current	IC	200	mAdc
Total Device Dissipation (α T _A = 25°C Derate above 25°C	PD	0.36 2.06	Watt mW/°C
Total Device Dissipation (α T _C = 25°C Derate above 25°C	PD	1.2 6.9	Watts mW/°C
Operating and Storage Temperature Temperature Range	T _J , T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.15	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.49	°C/W

2N3546

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		Total Control		20
Collector-Emitter Breakdown Voltage (1) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	12		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	15	3.0	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	4.5	_	Vdc
Base Cutoff Current (VCE = 10 Vdc, VBE(off) = 3.0 Vdc)	IBEV	_	0.10	μAdc
Collector Cutoff Current (V _{CE} = 10 Vdc, V _{BE(off)} = 3.0 Vdc)	ICEX	-	0.010	μAdc
Collector Cutoff Current $(V_{CB} = 10 \text{ Vdc})$ $(V_{CB} = 10 \text{ Vdc}, T_{A} = 150^{\circ}\text{C})$	ІСВО	=	0.010 10	μAdc

ON CHARACTERISTICS

DC Current Gain (1)		hFE		31251 = 17	_
(I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc, T _A = -55°C) (I _C = 50 mAdc, V _{CE} = 1.0 Vdc) (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)			20 30 15 25 15	120	001
Collector-Emitter Saturation Voltage (1) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	1	VCE(sat)		0.15 0.25 0.50	Vdc
Base-Emitter Saturation Voltage (1) (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc) (IC = 100 mAdc, IB = 10 mAdc)		V _{BE} (sat)	0.7 0.8	0.9 1.3 1.6	Vdc

SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	700		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo}		6.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0 , f = 1.0 MHz)	C _{ibo}	-	5.0	pF

SWITCHING CHARACTERISTICS

Delay Time	$I_C = 50 \text{ mA}, I_{B1} = 5.0 \text{ mA}$	td	_	10	ns
Rise Time	V _{BE} = 2.0 V, V _{CC} = 3.0 V	t _r		15	ns ns
Storage Time	I _C = 50 mA, I _{B1} = I _{B2} = 5.0 mA	t _s		20	ns
Fall Time	V _{CC} = 3.0 V	tf		15	ns
Turn-On Time	rn-On Time			40	ns
Turn-Off Time		toff	47.440 <u>-</u>	30	ns
Total Control Charge (I _C = 50 mA, I _B = 5.0 mA, V _{CC} = 3.0 V)		QT		400	рС

(1) Pulse Test: PW = 300 μ s, Duty Cycle \leq 2.0%.



LIMITS OF SATURATION VOLTAGES $\begin{array}{c}
1.6 \\
B_F = 10 \\
1.4 \\
T_J = 25^{\circ}C
\end{array}$ $\begin{array}{c}
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MAX V_{BE(tat)} \\
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FIGURE 2

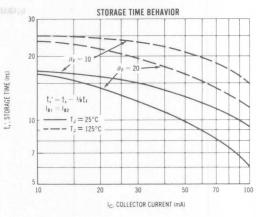
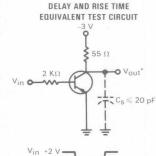


FIGURE 3



-10.8 V

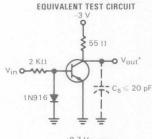
PULSE WIDTH = 200 ns
RISE TIME ≤ 2 ns
DUTY CYCLE ≤ 10%

OV

*OSCILLOSCOPE RISE TIME

1 ns

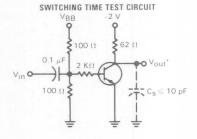
FIGURE 4 STORAGE AND FALL TIME



Vin -11.3 V

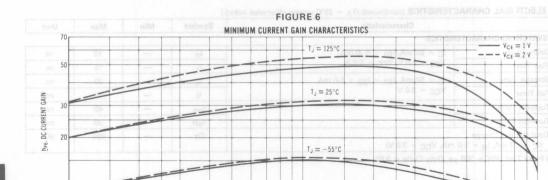
PULSE WIDTH = 200 ns RISE TIME ≤ 2 ns DUTY CYCLE ≤ 10%

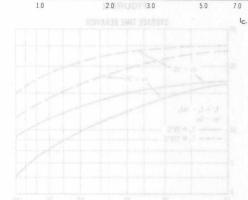
FIGURE 5

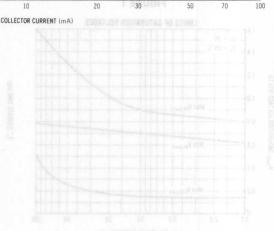


PULSE WIDTH > 200 nsRISE TIME < 2 ns $Z_{in} = 50 \Omega$

 t_{on} : $V_{BB} = +3 \text{ V}$, $V_{in} = -7 \text{ V}$ t_{off} : $V_{BB} = -4 \text{ V}$, $V_{in} = +6 \text{ V}$









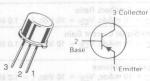






2N3634 thru 2N3637

JAN, JTX AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-39-205AD)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

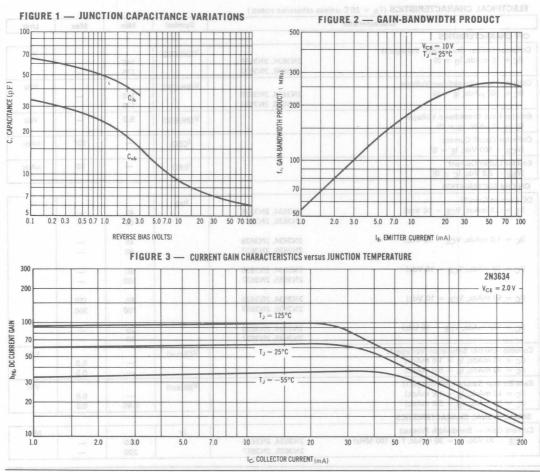
MAXIMUM RATINGS

A-OLX Rating	Symbol	2N3634 2N3635	2N3636 2N3637	Unit
Collector-Emitter Voltage	VCEO	140	175	Vdc
Collector-Base Voltage	VCBO	140	175	Vdc
Emitter-Base Voltage	V _{EBO}	1 5	3835, 240.	Vdc
Collector Current — Continuous	or Ic	1	.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.71		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	o +200	0 2°c, Am 0.0

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) Min Characteristic Symbol Max Unit OFF CHARACTERISTICS Collector-Emitter Breakdown Voltage(1) V(BR)CEO Vdc $(I_C = 10 \text{ mAdc}, I_B = 0)$ 2N3634, 2N3635 140 2N3636, 2N3637 175 Collector-Base Breakdown Voltage V(BR)CBO Vdc $(I_C = 100 \ \mu Adc, I_E = 0)$ 2N3634, 2N3635 140 2N3636, 2N3637 175 Emitter-Base Breakdown Voltage 5.0 Vdc V(BR)EBO $(I_E = 10 \ \mu Adc, I_C = 0)$ $\begin{array}{ll} \text{Collector Cutoff Current} \\ \text{(V}_{\text{CB}} = 100 \text{ Vdc, I}_{\text{E}} = 0) \end{array}$ 100 ICBO **Emitter Cutoff Current** 50 nAdc $(V_{BE} = 3.0 \text{ Vdc}, I_{C} = 0)$ ON CHARACTERISTICS DC Current Gain(1) hFE $(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ 2N3634, 2N3636 40 2N3635, 2N3637 80 (I_C = 1.0 mAdc, V_{CE} = 10 Vdc) 2N3634, 2N3636 45 2N3635, 2N3637 90 $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ 2N3634, 2N3636 50 2N3635, 2N3637 100 2N3634, 2N3636 150 $(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ 50 2N3635, 2N3637 100 300 $(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ 2N3634, 2N3636 25 2N3635, 2N3637 50 Collector-Emitter Saturation Voltage(1) VCE(sat) Vdc $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$ $(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$ 0.3 0.5 Base-Emitter Saturation Voltage(1) VBE(sat) Vdc $(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$ $(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$ 0.8 0.65 0.9 SMALL-SIGNAL CHARACTERISTICS Current-Gain — Bandwidth Product MHz $(V_{CE} = 30 \text{ Vdc}, I_{C} = 30 \text{ mAdc}, f = 100 \text{ MHz})$ 2N3634, 2N3636 150 2N3635, 2N3637

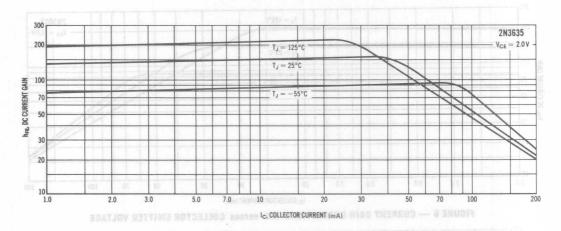
	Characteristic		Symbol	Min	Max	Unit	
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0,				C _{obo}	-	10	pF
Input Capacitance (VBE = 1.0 Vdc, IC = 0,				C _{ibo}	-	75	pF
Input Impedance (I _C = 10 mAdc, V _{CE} = 1			34, 2N3636 35, 2N3637	h _{ie}	100 200	600 1200	ohms UMDCAM
Voltage Feedback Ratio (I _C = 10 mAdc, V _{CE} =	10 Vdc, f = 1.0 kHz)	HeU Y	SNIGGE SNIGG	hambre	-	3.0	X 10-4
Small-Signal Current Gain (IC = 10 mAdc, VCE = 10 Vdc, f = 1.0 kHz)			34, 2N3636	hfe he	40	160	
			35, 2N3637	083V	80		
Output Admittance (I _C = 10 mAdc, V _{CE} =	10 Vdc, f = 1.0 kHz)			h _{oe}	nuo ue	200	
Noise Figure (IC = 0.5 mAdc, VCE =	10 Vdc, R _S = 1.0 k ohm	ns, f = 1.0 kHz)	5.71	NF			dB
SWITCHING CHARACTER	ISTICS	3ºWm	28.0				Devate ab
Turn-On Time	(V _{CC} = 100 Vdc, V _{BE}	= 4.0 Vdc,	- 65 to +200	ton	neitoni	400	ns 90
Turn-Off Time	$I_C = 50 \text{ mAdc}, I_{B1} = I_{C}$	B2 = 5.0 mAdd	:)	toff		600	ns

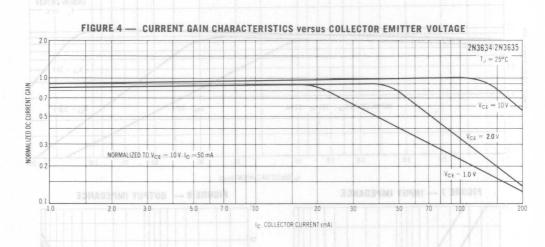
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

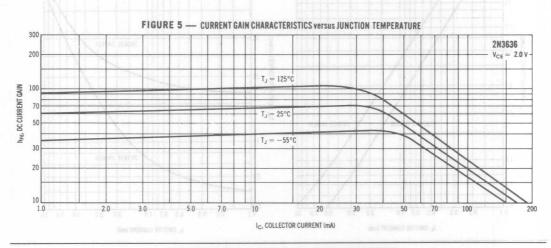


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS









0.5

0.2 0.3

0.5 0.7 1.0

IE, EMITTER CURRENT (mA)

2.0 3.0



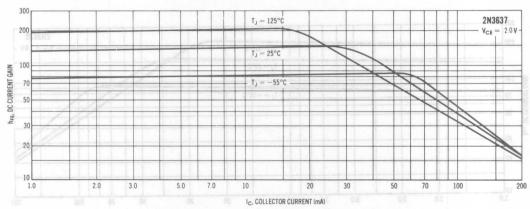
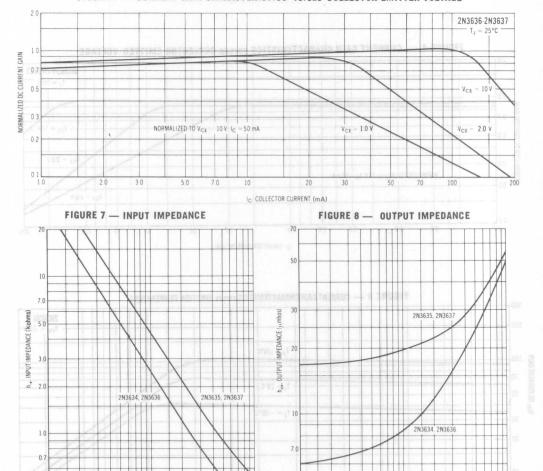


FIGURE 6 — CURRENT GAIN CHARACTERISTICS VERSUS COLLECTOR EMITTER VOLTAGE



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

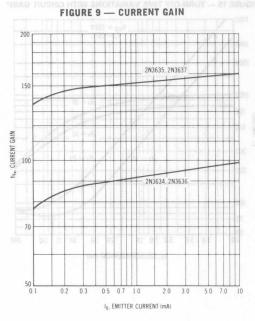
0.2 0.3

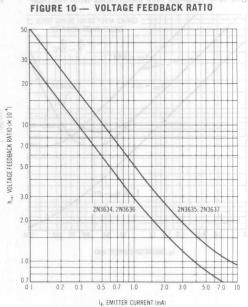
2.0 3.0

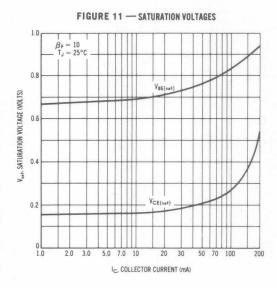
IE. EMITTER CURRENT (mA)

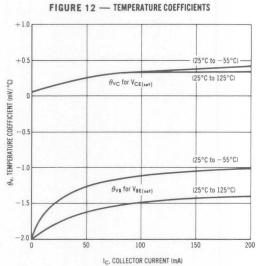
5.0 7.0 10

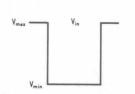












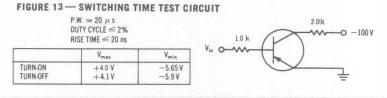
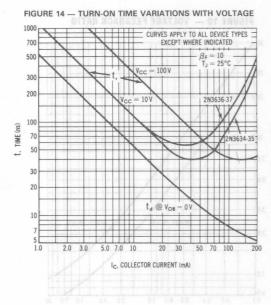
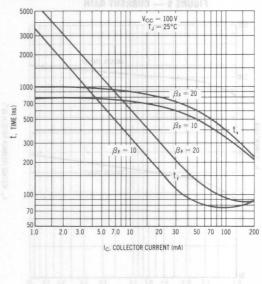
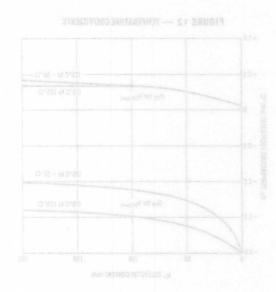
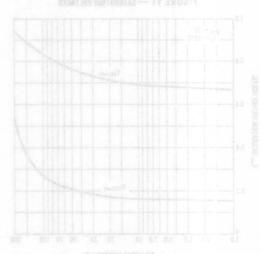


FIGURE 15 — TURN-OFF TIME VARIATIONS WITH CIRCUIT GAIN*



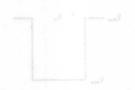












MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

2N3648

CASE 26-03, STYLE 1 TO-46 (TO-206AB)





SWITCHING TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	500	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	_{BOII} PD	400 2.28	mW mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	2.0 11.43	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

		Characteristic	Am Symbol	Min	Max	Unit
OFF CHARACT	TERISTICS		5 V, VCC - 6.0 V)	0 = 8aV		
Collector-Emit	ter Breakdown V Adc, I _B = 0)	oltage(1)	V(BR)CEO	15)III	_ 6	Vdc
Collector-Base (I _C = 10 μA	Breakdown Volt	age	V(BR)CBO		6A, Ig = 15	
Emitter-Base I (I _E = 10 μA	dc, I _C = 0)	ge	V(BR)EBO	6.0	Polse Width	Vdc
	/dc, V _{EB(off)} = 1	.0 Vdc) .0 Vdc, T _A = 150°C)	ICEX	=	0.025 50	μAdc
Base Cutoff C	urrent Vdc, V _{OB} = 1.0 \	/dc)	IBL	-	0.025	μAdc

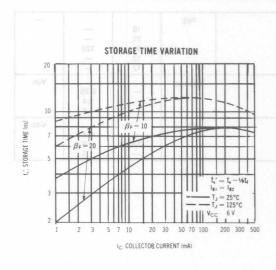
ON CHARACTERISTICS

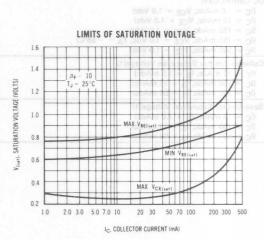
DC Current Gain (IC = 1.0 mAdc, V _{CE} = 1.0 Vdc) (IC = 10 mAdc, V _{CE} = 1.0 Vdc) (IC = 150 mAdc, V _{CE} = 1.0 Vdc) (IC = 150 mAdc, V _{CE} = 1.0 Vdc, T _A = -55°C)		HFE ROTTARA	15 25 30 12	_ 120 	-
$(I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	7.01		12		
Collector-Emitter Saturation Voltage(1) (IC = 10 mAdc, IB = 1.0 mAdc)		VCE(sat)		0.25	Vdc
(I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)			中国期	0.4	E1 E1
Base-Emitter Saturation Voltage(1)	7 2	VBE(sat)	- Dr - 10 -	BLL	Vdc
(I _C = 10 mAdc, I _B = 1.0 mAdc)	에 어디 불		444	0.8	-
(I _C = 150 mAdc, I _B = 15 mAdc)			0.8	1.0	5
(I _C = 500 mAdc, I _B = 50 mAdc)		Hilli	74-1111	1.5	

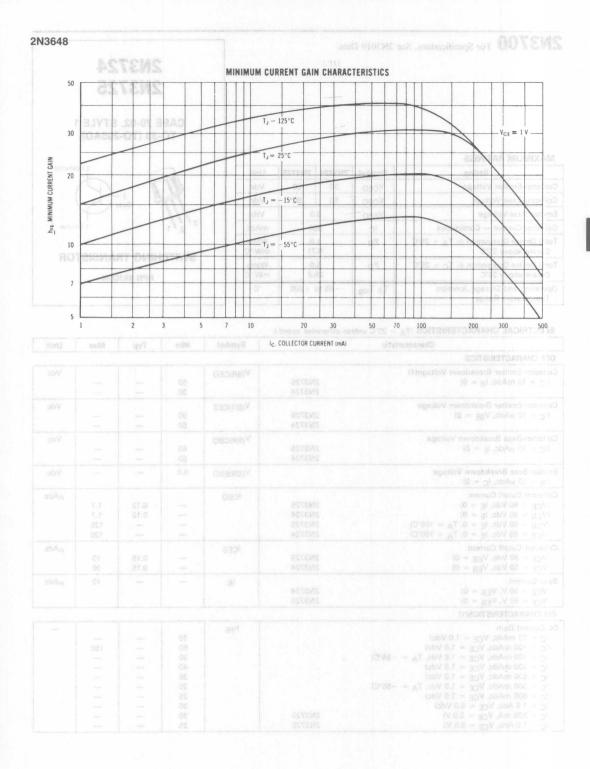
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

	Characteristic		Symbol	Min	Max	Unit	
SMALL-SIGNAL CHARAC	TERISTICS						
Output Capacitance (VCB = 10 Vdc, IE = 0,	f = 100 kHz)			C _{obo}	-	4.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0	ı, f = 100 kHz)			C _{ibo}	-	8.0	pF
Input Impedance (IC = 1.0 mA, VCE = 1	0 V, f = 1.0 kHz)	thitt	Value	hie	0.6	4.5	kohms
Voltage Feedback Ratio		yau	ar ar	030 hre		25	X 10-4
$(I_C = 1.0 \text{ mA}, V_{CE} = 1)$	0 V, f = 1.0 kHz)	989	- 40	VC80		e Voltage	es E-rotosii
Small-Signal Current Gair				ogg/hfe		Voltage	ozo-F ro ffi
(I _C = 15 mAdc, V _{CE} = 10 Vdc, f = 100 MHz) (I _C = 1.0 mA, V _{CE} = 10 Vdc, f = 1.0 kHz)		abAm	008	2)	4.5	150	no tessel
Output Admittance (I _C = 1.0 mA, V _{CF} = 10 V, f = 1.0 kHz)		O'Wm O'Wm	2.28	h _{oe}	10 A	100	μmhos
SWITCHING CHARACTER	ISTICS	Walter Co.	0.5	99	302 = 31	vesipalion in	an Davice
Delay Time 40000	(I _C = 150 mA, I _{B1} = 1	Ina = 15 mA	-65 to +200	t _d	-	8.0	ns
Rise Time	$V_{EB} = 0.5 \text{ V, } V_{CC} = 6.$	0 V)		tr	_	10	ns
Storage Time	(I _C = 150 mA, I _{B1} = -	I _{B2} =		ts	_	12	ns
Fall Time	15 mA, $V_{CC} = 6.0 \text{ V}$			Regime O t _f = /	ERISTICS (1)	8.0	A ns
Turn-On Time	(I _C = 150 mA, I _{B1} = 15 mA, V _{EB} = 0.5 V, V _{CC} = 6.0 V)		ton	— Chac	16	ns	
Turn-Off Time	(I _C = 150 mA, I _{B1} = -I _{B2} = 15 mA, V _{CC} = 6.0 V)		toff	vn Voltage(1)	obste 18	ns	
Total Control Charge (I _C = 150 mA, I _B = 15	mA, V _{CC} = 6.0 V)			Qτ	sperieV	300	pC

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.





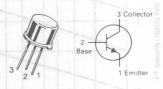


2N3724 2N3725

CASE 79-02, STYLE 1 TO-39 (TO-205AD)

MAXIMUM RATINGS

Rating	Symbol	2N3724	2N3725	Unit
Collector-Emitter Voltage	VCEO	30	50	Vdc
Collector-Base Voltage	VCBO	50	80	Vdc
Emitter-Base Voltage	VEBO	6	.0	Vdc
Collector Current — Continuous	Ic	500		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		.0 .71	Watts mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	o +200	°C



SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	dam tychraus #01011500 5f	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					В	
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	2N3725 2N3724	V(BR)CEO	50 30	=	=	Vdc
Collector-Emitter Breakdown Voltage (IC = 10 μ Adc, VBE = 0)	2N3725 2N3724	V _(BR) CES	80 50	=	_	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	2N3725 2N3724	V(BR)CBO	80 50	_	=	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		V(BR)EBO	6.0	-	-	Vdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0, T _A = 100°C) (V _{CB} = 60 Vdc, I _E = 0, T _A = 100°C)	2N3725 2N3724 2N3725 2N3724	ІСВО	=	0.12 0.12 —	1.7 1.7 120 120	μAdc
Collector Cutoff Current (V _{CE} = 80 Vdc, V _{EB} = 0) (V _{CE} = 50 Vdc, V _{EB} = 0)	2N3725 2N3724	CES	=	0.15 0.15	10 10	μAdc
Base Current $(V_{CE} = 50 \text{ V}, V_{EB} = 0)$ $(V_{CE} = 80 \text{ V}, V_{EB} = 0)$	2N3724 2N3725	IB	-		10	μAdc
ON CHARACTERISTICS(1)						
DC Current Gain $ \begin{aligned} &(I_C = 10 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 100 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 100 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 300 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 500 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc}) \\ &(I_C = 500 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc, } T_{A} = -55^{\circ}\text{C}) \\ &(I_C = 800 \text{ mAdc, } V_{CE} = 2.0 \text{ Vdc}) \\ &(I_C = 800 \text{ mAdc, } V_{CE} = 5.0 \text{ Vdc}) \\ &(I_C = 800 \text{ mA, } V_{CE} = 5.0 \text{ Vdc}) \\ &(I_C = 800 \text{ mA, } V_{CE} = 2.0 \text{ V}) \end{aligned} $	2N3725	hFE	30 60 30 40 35 20 25 30 20			

RIMINUM CURRENT GAIN CHARACTERISTICS

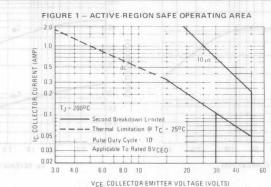
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

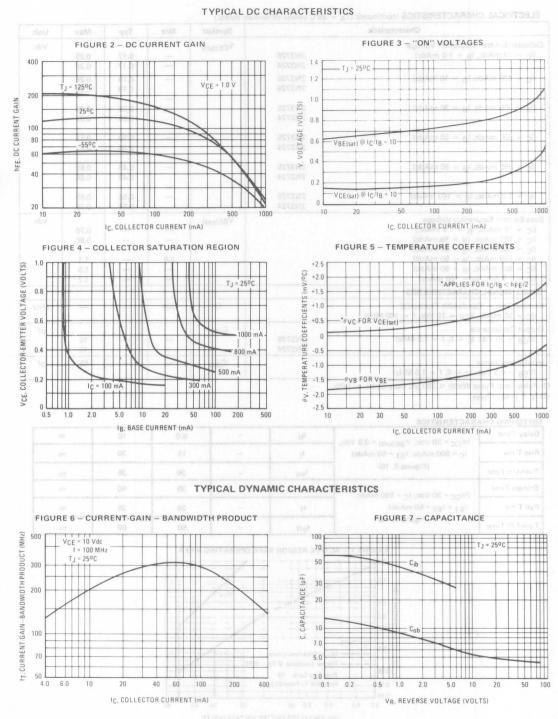
Characteristic		Symbol	Min	Тур	Max	Unit
Collector-Emitter Saturation Voltage		VCE(sat)	D THORS	19 38 - 5	FIGURE	Vdc
(IC = 10 mAdc, IB = 1.0 mAdc)	2N3725		_	0.17	0.25	
1998 1	2N3724		-	0.17	0.25	
(Ic = 100 mAdc, I _B = 10 mAdc)	2N3725		- 1	0.19	0.26	
	2N3724	V0.5 1 50V		0.19	0.20	
(IC = 300 mAdc, IB = 30 mAdc)	2N3725			0.25	0.40	
(IC = 300 mAdc, IB = 30 mAdc)	2N3724		and the second	0.25	0.32	
	2113724			0.20	0.52	
(I _C = 500 mAdc, I _B = 50 mAdc)	2N3725			0.30	0.52	
	2N3724			0.30	0.42	
(I _C = 800 mAdc, I _B = 80 mAdc)	2N3725		-	0.43	0.80	
	2N3724			0.43	0.65	
(IC = 1.0 mAdc, Ig = 100 mAdc)	2N3725			0.55	0.95	
THE STREET OF THE STREET	2N3724			0.55	0.75	
Base-Emitter Saturation Voltage	0401	V _{BE(sat)}	95 00	100	199	Vdc
(IC = 10 mAdc, IB = 1.0 mAdc)		(An	TVERBUS	HOMOS <u>TR</u> OD 19	0.76	
$(I_C = 100 \text{ mAdc}, I_B = 10 \text{ mAdc})$					0.86	
(I _C = 300 mAdc, I _B = 30 mAdc)		NOIDER NO	TABUTA	8 80 123	1.1 BB	
(I _C = 500 mAdc, I _B = 50 mAdc)		The second	0.8	TROTTER	1.1	
(IC = 800 mAdc, IB = 80 mAdc)					1.5	
IIC - 1.0 Adc, IB - 100 MAdc)					1.7	111
SMALL SIGNAL CHARACTERISTICS	and H					77 82
Current-Gain — Bandwidth Product(2)		fT	300	1011-11	-	MHz
$(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz})$	L		J.A.			- N
Output Capacitance		Cobo	1/1			pF
$(V_{CB} = 10 \text{ Vdc}, I_{E} = 0, f = 1.0 \text{ MHz})$	2N3725			/ III / []	10	
	2N3724	Amilian == 1111		110/11	12	++++0
Input Capacitance		Cibo	-	LV-11	55	pF
$(V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$		Am 308 MT				

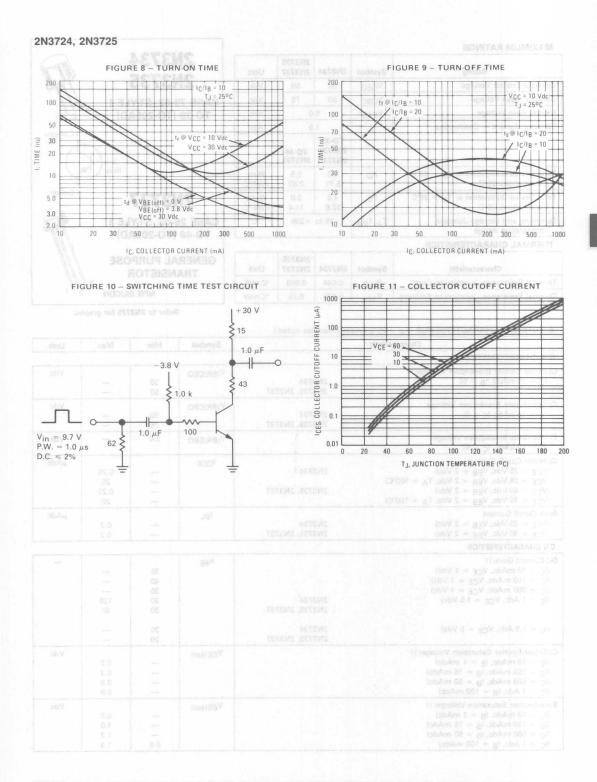
(1) Pulse Test: Pulse Width \leq 300 $\mu s,$ Duty Cycle = 1.0%. (2) fT = | hfe | * ftest.

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} = 30 Vdc, V _{BE} (off) = 3.8 Vdc, I _C = 500 mAdc, I _{B1} = 50 mAdc) (Figures 8, 10)	^t d		5.0	10	ns
Rise Time		t _r	-	15	30	ns
Turn-On Time		ton		20	35	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAdc) (Figures 9, 10)	TOARK HOOM	KCAL BYNAI	IVT 35	50	ns
Fall Time		tf		20	25	ns
Turn-Off Time		toff	TUBUURTI	50	60	ns







MAXIMUM RATINGS

Rating WAUT - 9 BAUS	Symbol	2N3734	2N3735 2N3737	Unit
Collector-Emitter Voltage	VCEO	30	50	Vdc
Collector-Base Voltage	VCBO	50	75	Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	Ic	1	.5	Adc
01-9801	X	TO-39 2N3734 2N3735	TO-46 2N3737	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.71	0.5 2.86	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	4.0 22.8	2.0 11.4	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to	+ 200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	2N3734	2N3735 2N3737	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.044	0.088	°C/mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.175	0.35	°C/mW

2N3734 2N3735

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





2N3737

CASE 26-03, STYLE 1 TO-46 (TO-206AD)

GENERAL PURPOSE TRANSISTOR

NPN SILICON



Refer to 2N3725 for graphs.

Characteristic		Symbol	Min	Max	Unit				
OFF CHARACTERISTICS									
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	2N3734 2N3735, 2N3737	V(BR)CEO	30 50		Vdc				
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	2N3734 2N3735, 2N3737	V(BR)CBO	50 75		Vdc				
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	0.0	V(BR)EBO	5.0	\$ 53	Vdc				
Collector Cutoff Current (VCE = 25 Vdc, VEB = 2 Vdc) (VCE = 25 Vdc, VEB = 2 Vdc, TA = 100°C) (VCE = 40 Vdc, VEB = 2 Vdc, TA = 100°C) (VCE = 40 Vdc, VEB = 2 Vdc, TA = 100°C)	2N3734 2N3735, 2N3737	CEX	Ē	0.20 20 0.20 20	μAdc				
Base Cutoff Current (V _{CE} = 25 Vdc, V _{EB} = 2 Vdc) (V _{CE} = 40 Vdc, V _{EB} = 2 Vdc)	2N3734 2N3735, 2N3737	IBL	=	0.3	μAdo				
ON CHARACTERISTICS					•				
DC Current Gain(1) (IC = 10 mAdc, V _{CE} = 1 Vdc) (IC = 150 mAdc, V _{CE} = 1 Vdc)		hFE	35 40	=	_				

(I _C = 10 mAdc, V _{CE} = 1 Vdc) (I _C = 150 mAdc, V _{CE} = 1 Vdc) (I _C = 500 mAdc, V _{CE} = 1 Vdc) (I _C = 1 Adc, V _{CE} = 1.5 Vdc)	2N3734 2N3735, 2N3737		35 40 35 30 20		
$(I_C = 1.5 \text{ Adc}, V_{CE} = 5 \text{ Vdc})$	2N3734 2N3735, 2N3737		30 20	_	
Collector-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1 mAdc) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1 Adc, I _B = 100 mAdc)		VCE(sat)	Ē	0.2 0.3 0.5 0.9	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1 mAdc) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1 Adc, I _B = 100 mAdc)		VBE(sat)	 0.9	0.8 1.0 1.2 1.4	Vdc

Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 100 kHz)					C _{obo}	-	9.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)					C _{ibo}	-	- 80	pF
Small-Signal Current Gain (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	tints	Value	ladr	nv2	hfe	2.5	BOMIT <u>A</u> A ME Badas	NAT X TIME
SWITCHING CHARACTERISTICS	nlaV	300	-03	nV.			patiev veitien	d-nome la
Turn-On Time (V _{CC} = 30 V, V _{BE(off)} = 2.0 V, I _C = 1.0 Amp, I _B	1 = 100 mA	300	08	οV	ton	_	aga; 40 aga	ns ns
Turn-Off Time $(V_{CC} = 30 \text{ V}, V_{BE(off)} = 2.0 \text{ V}, I_{C} = 1.0 \text{ Amp, Ig}$	1 = 100 mA			1	toff	tinuova		
Total Control Charge (I _C = 1 Amp, I _B = 100 mA, V _{CC} = 30 V)	White Co.Mhu	1.0	¢	9	Q_T	300E = <u>A</u> 1 10	10	NC
1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2	2.0%.	5,0	o	9		(n 1g = 25 C	o Dissipation cove 26°C	

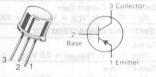
se Emmer Saturation Voltage(3) inc = 10 mAdo, tg = 1 mAdo) inc = 30 mAdo, tg = 3 mAdo)		
::::: Capacitance νεβ – 1.0 Vdα, IC = 0, f = 100 sHz)		
		p-01 X
sell-Signal Current Gein Voc. = 10 V, Ic. = 10 mA, f = 1 kHz)		

2N3743

JAN, JTX AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	300	Vdc
Collector-Base Voltage	VCBO	300	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	IC	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.7	Watts mW/°C
Total Device Dissipation $@T_C = 25^{\circ}C$ Derate above 25°C	PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C



AMPLIFIER TRANSISTOR

PNP SILICON

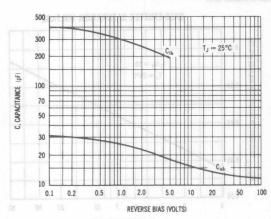
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO	300		Vdc	
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc$, $I_E = 0$)	V(BR)CBO	300		Vdc	
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)	V(BR)EBO	5.0		Vdc	
Collector Cutoff Current (V _{CB} = 200 Vdc, I_E = 0) (V _{CB} = 200 Vdc, I_E = 0, T_A = 100°C)	ІСВО	Ξ	0.3 30	μAdc	
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)	IEBO	-	0.1	μAdc	
ON CHARACTERISTICS					
DC Current Gain(2)	hFE	20 25 25 25 25 25		-	
Collector-Emitter Saturation Voltage(2) (IC = 10 mAdc, IB = 1 mAdc) (IC = 30 mAdc, IB = 3 mAdc)	VCE(sat)	Ξ	5.0 8.0	Vdc	
Base-Emitter Saturation Voltage(2) (IC = 10 mAdc, IB = 1 mAdc) (IC = 30 mAdc, IB = 3 mAdc)	V _{BE} (sat)	=	1.0 1.2	Vdc	
SMALL-SIGNAL CHARACTERISTICS					
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	-	15	pF	
Input Capacitance (VEB = 1.0 Vdc, $I_C = 0$, $f = 100 \text{ kHz}$)	C _{ibo}	-	400	pF	
Input Impedance ($V_{CE} = 10 \text{ V, I}_{C} = 10 \text{ mA, f} = 1 \text{ kHz}$)	h _{ie}	-	1.0	kohms	
Voltage Feedback Ratio ($V_{CE} = 10 \text{ V}$, $I_{C} = 10 \text{ mA}$, $f = 1 \text{ kHz}$)	h _{re}		4.0	X 10-4	
Small-Signal Current Gain $(V_{CE} = 10 \text{ V, I}_{C} = 10 \text{ mA, f} = 1 \text{ kHz})$	hfe	30	300	_	

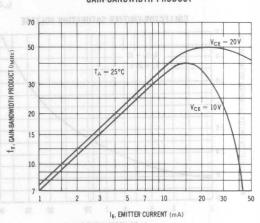
Characteristic	Symbol	Min	Max	Unit
Current Gain — High Frequency (IC = 10 mAdc, VCE = 20 Vdc, f = 20 MHz)	h _{fe}	1.5		75.05
Output Admittance (V _{CE} = 10 V, I _C = 10 mA, f = 1 kHz)	h _{oe}	-	200	μmhos
Real Part of Input Impedance (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 5 MHz)	Re(h _{ie})	-	40	ohms

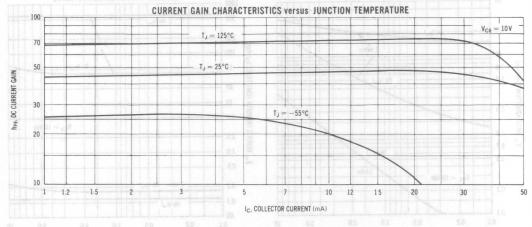
⁽¹⁾ PW \leq 30 μ s, Duty Cycle \leq 1.0%.

JUNCTION CAPACITANCE

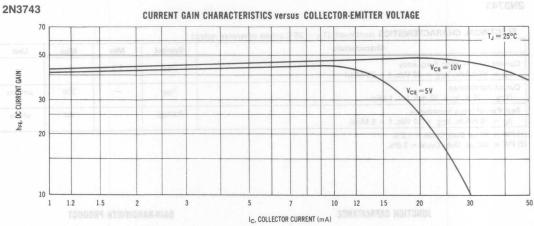


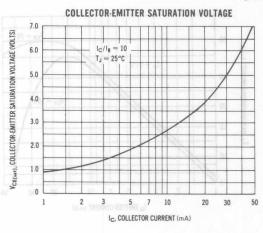
GAIN-BANDWIDTH PRODUCT

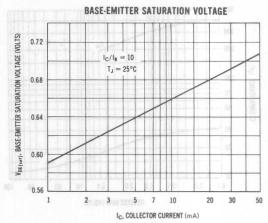




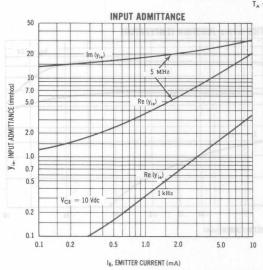
⁽²⁾ PW \leq 300 μ s, Duty Cycle \leq 2.0%.

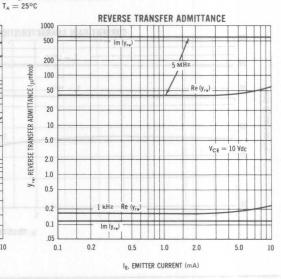




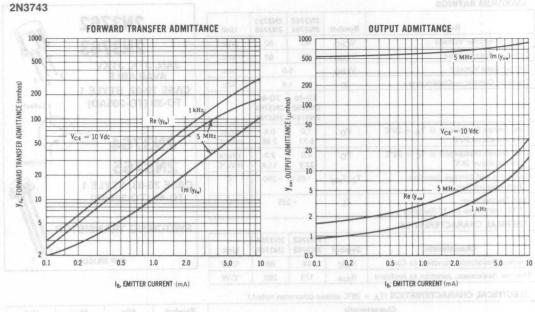


SMALL SIGNAL Y PARAMETERS





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



		2N3702. 2N3764 2N3763 2N3765	
			ese Emitter Saturation Voltago(1) Up = 10 mAde, tg = 1.0 mAde) Lo = 15 mAde, tg = 15 mAde) Lo = 15 mAde, tg = 50 mAde) Up = 1.0 Ade, tg = 100 mAde)

MAYIMI IM PATINGS

Symbol	2N3762 2N3764	2N3763 2N3765	Unit
VCEO	40	60	Vdc
VCBO	40	60	Vdc
VEBO	5.0		Vdc
IC	1.5		Adc
	TO-39 2N3762 2N3763	TO-46 2N3764 2N3765	
PD	1.0 5.71	0.5 2.86	Watt mW/°C
PD	4.0 22.8	2.0 11.4	Watts mW/°C
TJ, T _{stg}	-65 to +200		°C
TL	+ 235		°C
	VCEO VCBO VEBO IC PD PD TJ, Tstg	Symbol 2N3764 VCEO 40 VCBO 40 VEBO 5 IC 1 TO-39 2N3762 2N3763 2N3763 PD 1.0 5.71 PD 4.0 22.8 TJ, Tstg -65 te	Symbol 2N3764 2N3765 VCEO 40 60 VCBO 40 60 VEBO 5.0 1.5 TO-39 2N3762 2N3762 2N3763 2N3765 2N3764 2N3765 2N3765 PD 1.0 0.5 5.71 2.86 PD 4.0 2.0 22.8 11.4 2.0 22.8 11.4 TJ, Tstg -65 to +200 -65 to +200

JAN, JTX, JTXV AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)



2N3764

2N3765

CASE 26-03, STYLE 1 TO-46 (TO-206AB)

SWITCHING TRANSISTOR

PNP SILICON

Characteristic	Symbol	2N3762 2N3763	2N3764 2N3765	Unit
Thermal Resistance, Junction to Case	$R_{\theta}JC$	1.044	88	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	175	350	°C/W

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) $(I_C = 10 \text{ mAdc}, I_B = 0)$	2N3762, 2N3764 2N3763, 2N3765	V(BR)CEO	40 60	_	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	2N3762, 2N3764 2N3763, 2N3765	V(BR)CBO	40 60	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		V(BR)EBO	5.0	_	Vdc
Collector Cutoff Current (VCE = 20 Vdc, VEB = 2.0 Vdc) (VCE = 20 Vdc, VEB = 2.0 Vdc, TA = 100°C) (VCE = 30 Vdc, VEB = 2.0 Vdc) (VCE = 30 Vdc, VEB = 2.0 Vdc, TA = 100°C)	2N3762, 2N3764 2N3763, 2N3765	ICEX		0.10 10 0.10 10	μAdo
Base Cutoff Current (V _{CE} = 20 Vdc, V _{EB} = 2.0 Vdc) (V _{CE} = 30 Vdc, V _{EB} = 2.0 Vdc)	2N3762, 2N3764 2N3763, 2N3765	^I BL	Ξ	0.2 0.2	μAdo
ON CHARACTERISTICS					
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 150 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 1.5 Vdc) (I _C = 1.5 Adc, V _{CE} = 5.0 Vdc)	2N3762, 2N3764 2N3763, 2N3765 2N3762, 2N3764	₽₽E	35 40 35 30 20	120 80	
Collector-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)	2N3763, 2N3765	VCE(sat)		0.1 0.22 0.5 0.9	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)		V _{BE(sat)}	_ _ _ _ 0.9	0.8 1.0 1.2 1.4	Vdc

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

	Characteristic		Symbol	Min	Max	Unit
SMALL-SIGNAL CH	ARACTERISTICS	d+ bdd+ 01 -	Version Level		1, 25°C	-101
Output Capacitance (V _{CB} = 10 Vdc, I _E	= 0, f = 100 kHz)	n+	C _{obo}		15	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)		Cibo		80	pF	
Current Gain — High Frequency (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz) 2N3762, 2N3764 2N3763, 2N3765		h _{fe}	1.8 1.5		4.0	
SWITCHING CHAR	ACTERISTICS					
Delay Time	$(V_{CC} = 30 \text{ V}, V_{BE(off)} = 2.0 \text{ V},$	4-	t _d		8.0	ns
Rise Time	$I_C = 1.0 \text{ Amp, } I_{B1} = 100 \text{ mA})$	-401 = 01	tr		3.5	ns
Storage Time	$(V_{CC} = 30 \text{ V}, I_{C} = 1.0 \text{ Amp},$		ts	- 04	80	ns
Fall Time	$I_{B1} = -I_{B2} = 100 \text{ mA}$		tf	ACCOUNT OF	35	ns
Total Control Charg	e 3 = 100 mA, V _{CC} = 30 V)		Q_{τ}		30	pC

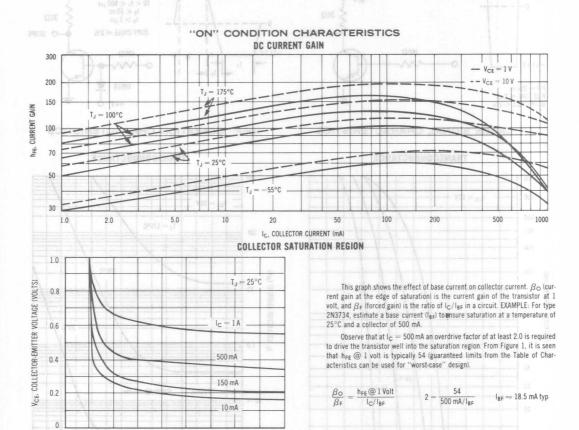
(1) Pulse Test: PW ≤ 300 μs, Duty Cycle ≤ 2.0%.

2

3

 $\beta_{\rm O}/\beta_{\rm F}$, OVERDRIVE FACTOR

4



0.2

"ON" VOLTAGES

TEMPERATURE COEFFICIENTS

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

0.2 0.1

VBE, BASE-EMITTER VOLTAGE (VOLTS)

0.5

1.2

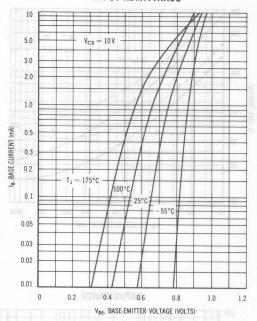
0.8

1.0

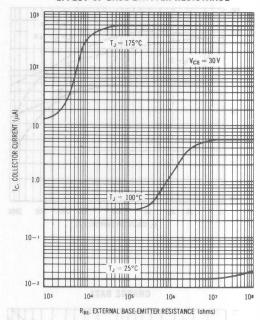
0.6

VBE, BASE-EMITTER VOLTAGE (VOLTS)



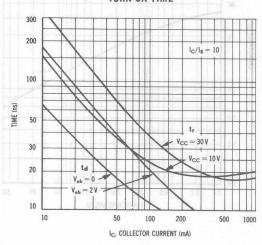


EFFECT OF BASE-EMITTER RESISTANCE

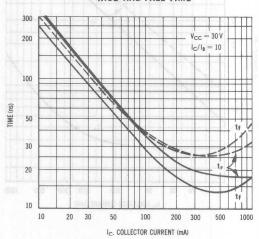


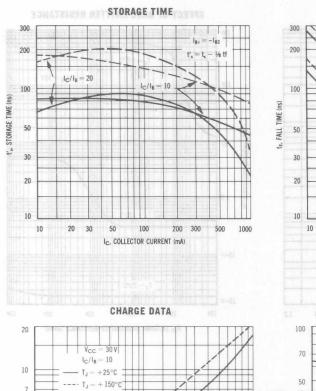
- T, = 25°C SWITCHING CHARACTERISTICS -- T, = 150°C

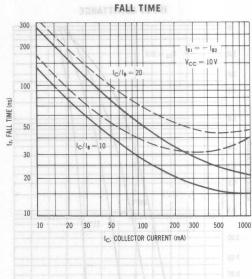


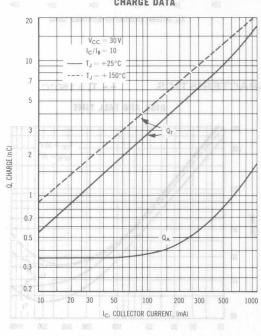


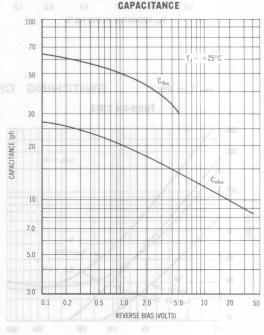
RISE AND FALL TIME

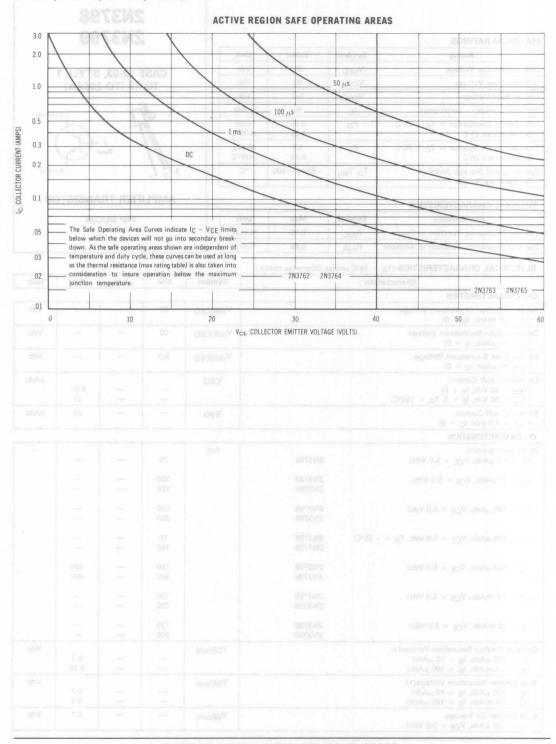










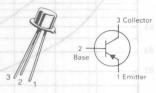


MAXIMUM RATINGS			1
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	60	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	IC	50	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.36 2.06	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.2 6.86	Watts mW/°C
Operating and Storage Junction	T _J , T _{stg}	-65 to +200	°C

CASE 22-03, STYLE 1

ZN3/99

TO-18 (TO-206AA)



THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.15	°C/mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.49	°C/mW

AMPLIFIER TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS	(TA =	25°C unless	otherwise no	ted.)
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Characteristic	A STATE OF THE STA	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		1				1
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	, ac	V(BR)CEO	60	0)	_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	E. CONISCION EMITTEN VOLTAGE (VOLTS)	V(BR)CBO	60	-	_	Vdc
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$		V _{(BR)EBO}	5.0	-	_	Vdc
Collector Cutoff Current $(V_{CB} = 50 \text{ Vdc}, _{E} = 0)$ $(V_{CB} = 50 \text{ Vdc}, _{E} = 0, T_{A} = 150^{\circ}\text{C})$		ICBO	=	=	0.01 10	μAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, I _C = 0)		IEBO	_	-	20	nAdc
ON CHARACTERISTICS						
DC Current Gain(1) (I _C = 1.0 μ Adc, V _{CE} = 5.0 Vdc)	2N3799	hFE	75	-	_	-
(I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	2N3798 2N3799		100 225	=	=	
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N3798 2N3799		150 300	=	=	
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_A = -55^{\circ}C$	2N3798 2N3799		75 150	=	=	
(I _C = 500 μ Adc, V _{CE} = 5.0 Vdc)	2N3798 2N3799		150 300	=	450 900	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	2N3798 2N3799		150 300	=	=	
$(I_C = 10 \text{ mAdc, } V_{CE} = 5.0 \text{ Vdc})$	2N3798 2N3799		125 250	Ξ	=	
Collector-Emitter Saturation Voltage(1) (IC = 100 μ Adc, IB = 10 μ Adc) (IC = 1.0 mAdc, IB = 100 μ Adc)		VCE(sat)	Ξ	=	0.2 0.25	Vdc
Base-Emitter Saturation Voltage(1) (IC = 100 μ Adc, IB = 10 μ Adc) (IC = 1.0 mAdc, IB = 100 μ Adc)		V _{BE(sat)}	=	=	0.7 0.8	Vdc
Base-Emitter On Voltage (I _C = 100 µAdc, V _{CF} = 5.0 Vdc)		V _{BE} (on)	-	-	0.7	Vdc

Characteristic	THE REAL PROPERTY AND THE PARTY Symbol	Min	Тур	Max	Unit	
CAMALL CICAIAL CHAPACTERISTICS	14 800 ± 10 A. D. = 4 = 1000 M					
(1 E00 Ada V E0 Vda f - 30 MHz)	te = 1.0 ma, R ₁ = 1.0 ms to = 10 aA, R ₂ = 10 ms	fT	30 100		500	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)		C _{obo}		-	4.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)		C _{ibo}	10 T 10 T 10 T 10 T 10 T 10 T 10 T 10 T	-	8.0	pF
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	2N3798 2N3799	h _{ie}	3.0 10	=	15 40	k ohms
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	t saednewe, tast	h _{re}	-	-	25	X 10-4
Small-Signal Current Gain (IC = 1.0 mAdc, VCE = 10 Vdc, f = 1.0 kHz)	2N3798 2N3799	h _{fe}	150 300	=	600 900	_
Output Admittance (IC = 1.0 mAdc, VCE = 10 Vdc, f = 1.0 kHz)		hoe	5.0	MALTER	60	μmhos
Noise Figure (IC = 100 μ Adc, VCE = 10 Vdc, RG = 3.0 k ohms), f = 100 Hz, B.W. = 20 Hz	2N3798 2N3799	NF 15V 8 2 = 33V		4.0	7.0	dB
Spot f = 1.0 kHz, B.W. = 200 Hz Noise	2N3798 2N3799	- TA = 1280C		1.5	3.0	au :
f = 10 kHz, B.W. = 2.0 kHz	2N3798 2N3799	1988 = A1		1.0 0.8	2.5 1.5	2002
Broadband Noise-Bandwidth 10 Hz to 15.7 kHz	2N3798 2N3799			2.5 1.5	3.5 2.5	

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SPOT NOISE FIGURE (V_{CE} = 10 Vdc, T_A = 25°C)

FIGURE 1 — SOURCE RESISTANCE EFFECTS, f = 1.0 kHz

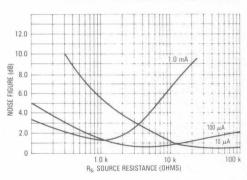


FIGURE 2 — SOURCE RESISTANCE EFFECTS, f = 10 Hz

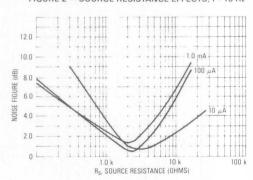


FIGURE 3 — FREQUENCY EFFECTS

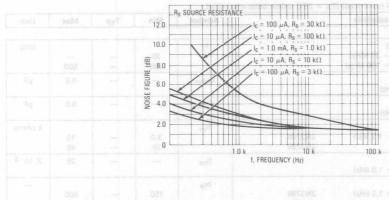


FIGURE 4a — TYPICAL CURRENT
GAIN CHARACTERISTICS—2N3798

500

VCE = 5.0 Vdc

VCE = 5.0 Vdc

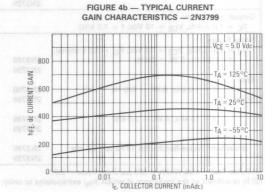
TA = 125°C

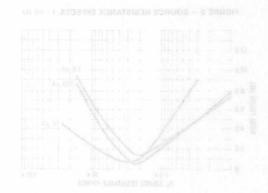
TA = 25°C

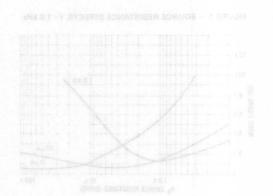
0

0.01

Ic. COLLECTOR CURRENT (mAdc)







MAXIMUM RATINGS

	Rating	Symbol	Value	Unit
Collector	-Emitter Voltage	VCEO	40	Vdc
Collector	r-Base Voltage	Vсво	ahea 60	Vdc
Emitter-6	Base Voltage	VEBO	6.0	Vdc
Collector	Current — Continuous	IC	200	mAdc
	vice Dissipation @ T _A = 25°C above 25°C	PD	0.36 2.06	Watt mW/°C
	vice Dissipation (a T _C = 25°C above 25°C	PD	6.9	Watts mW/°C
200000000000000000000000000000000000000	g and Storage Junction erature Range	T _J , T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.15	°C/mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	0.49	°C/mW

2N3946 2N3947

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	(0) = 51 × 0.5	- 22.		
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc)	V _{(BR)CEO}	40	ANC SILVERS SE	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	V _(BR) CBO	60	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V _{(BR)EBO}	6.0	-	Vdc
Collector Cutoff Current (V _{CE} = 40 Vdc, V _{OB} = 3.0 Vdc) (V _{CE} = 40 Vdc, V _{OB} = 3.0 Vdc, T _A = 150°C)		Y1_	0.010 15	μAdo
Base Cutoff Current (before exhaustro asolnu 0°05) (V _{CE} = 40 Vdc, V _{CB} = 3.0 Vdc)	A IBL	-	.025	μAdo

ON CHARACTERISTICS

DC Current Gain(1) (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc)		2N3946	3/4/hFE/2/3	30		_
		2N3947		60	14-1	and the
(I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc)		2N3946		45	HLK	907
0(- 1/-5)		2N3947		90	F	4 ox.
$(I_C = 10 \text{ mAdc, } V_{CE} = 1.0 \text{ Vdc})$		2N3946 2N3947		50 100	150 300	d 081 =
(I _C = 50 mAdc, V _{CE} = 1.0 Vdc)	07 18	2N3946 2N3947		20 40		日 60 星
Collector-Emitter Saturation Voltage(1)			VCE(sat)	1 404	KILL	Vdc
(I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)		- Canal			0.2	0.
Base-Emitter Saturation Voltage(1) (I _C = 10 mAdc, I _B = 1.0 mAdc)	N7	HTU	V _{BE(sat)}	0.6	0.9	Vdc
$(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$		02 05 0	01 0	v 0.5 0.6	1.0	0.1

SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product ($I_C = 10 \text{ mAdc}$, $V_{CE} = 20 \text{ Vdc}$, $f = 100 \text{ MHz}$)	2N3946 2N3947	fT	250 300	=	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)		C _{obo}	-	4.0	ρF

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characterist	ic				Min	Max	Unit
Input Capacitance (VBE = 1.0 Vdc, I _C = 0, f = 100 kHz)			lotte	Cibo	gn	8.0 Rati	pF
Input Impedance	SDV	40	03	hie	9.6	nioa jeniu-	kohms
(IC = 1.0 mA, VCE = 10 V, f = 1.0 kHz)		2N3946			0.5	6.0	
(MOKBBERGIT) 61-01	abV	2N3947	O.S.		2.0	12	B-18 thim 3
Voltage Feedback Ratio (I _C = 1.0 mA, V _{CE} = 10 V, f = 1.0 kHz)		2N3946		h _{re}	soounbro	0 — (nanu)	X 10-4
		2N3947		9 3	M III IA = 25°	20	Total Co.
Small Signal Current Gain (I _C = 1.0 mA, V _{CE} = 10 V, f = 1.0 kHz)	2 Wills	00/5		h _{fe}	A STATE OF THE STATE OF	Olea arous	All the second
		2N3946 2N3947			50 100	250 700	Total Dev
Output Admittance	3	-65 to +200	pre ¹	hoe	noitanul	and Storage	μmhos
$(I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz})$		2N3946			1.0	30	
		2N3947			5.0	50	
Collector Base Time Constant				rb'C _C	TERISTICS	200	ps
$(I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 31.8 \text{ MHz})$	Bell	Max	fedi	Syn	pitting	Charact	
Noise Figure (I _C = 100 μ A, V _{CF} = 5.0 V, R _Q = 1.0 k Ω , f =	10 Hz to 15.7 kH	27.0		A NF	unction to Case	5.0	dB
(IC = 100 pm, VCE = 5.0 V, Hg = 1.0 KIL, I	10 112 10 10.7 101	00.0	20.1	AND MADE	unió es entrena	L saverie so	Theory of T

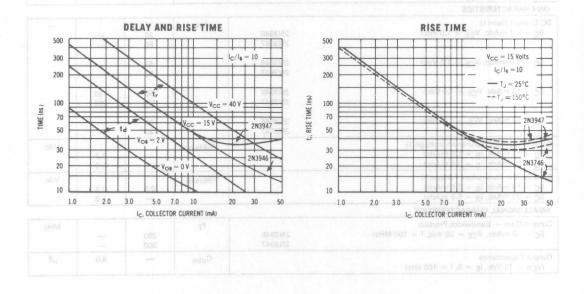
SWITCHING CHARACTERISTICS

Delay Time	$V_{CC} = 3.0 \text{ Vdc}, V_{OB} = 0.5 \text{ Vdc},$		td	entrosouve.	35	ns
Rise Time	I _C = 10 mAdc, I _{B1} = 1.0 mA	on serviento deemo	t _r	A	35	ns
Storage Time	V _{CC} = 3.0 V, I _C = 10 mA,	2N3946 2N3947	t _s		300 375	ns ns
Fall Time	$I_{B1} = I_{B2} = 1.0 \text{ mAdc}$		tf	down Voltage	75	ns

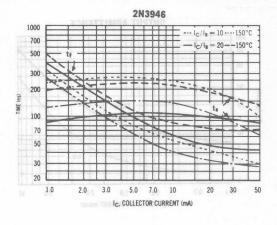
(1) Pulse Test: PW ≤ 300 µs, Duty Cycle ≤ 2%.

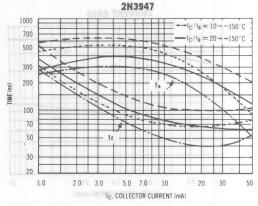
TYPICAL SWITCHING CHARACTERISTICS

(T_A= 25°C unless otherwise noted)

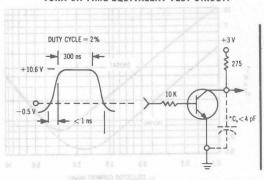




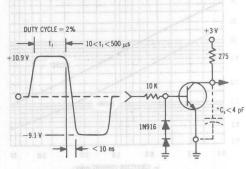




TURN-ON TIME EQUIVALENT TEST CIRCUIT

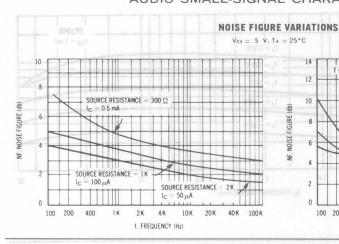


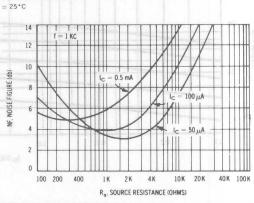
TURN-OFF TIME EQUIVALENT TEST CIRCUIT



*TOTAL SHUNT CAPACITANCE OF TEST JIG AND CONNECTORS

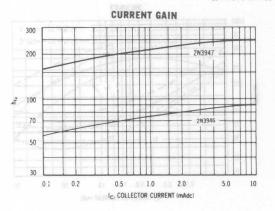
AUDIO SMALL-SIGNAL CHARACTERISTICS

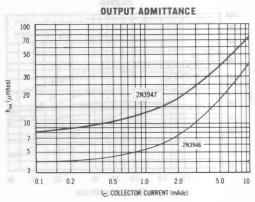


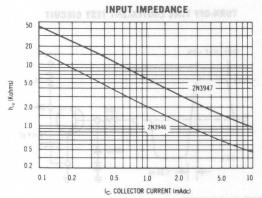


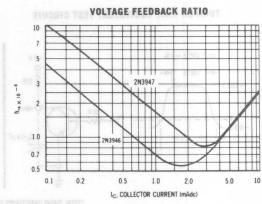
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

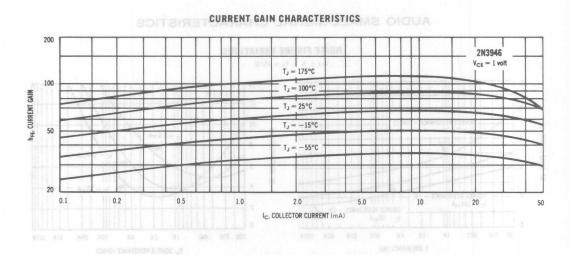
Vcs = 10 V. TA = 25°C. f = 1 Kc



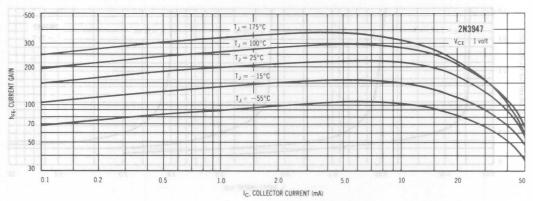


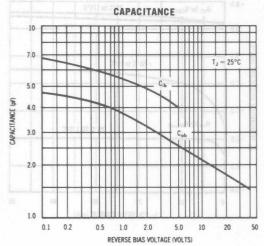




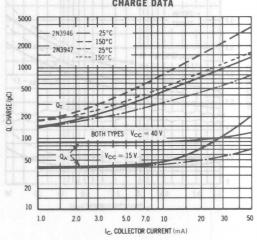




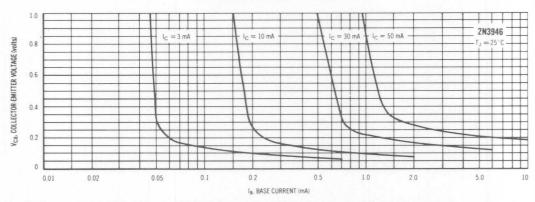




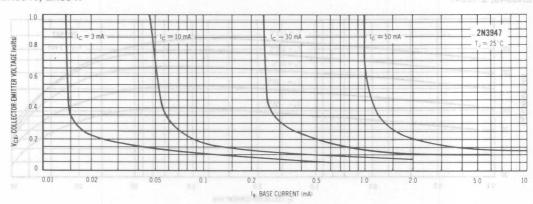
CHARGE DATA



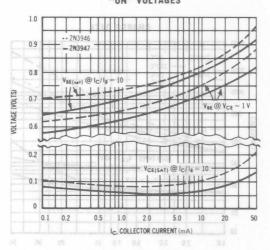
COLLECTOR SATURATION REGION



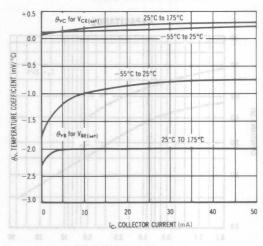
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



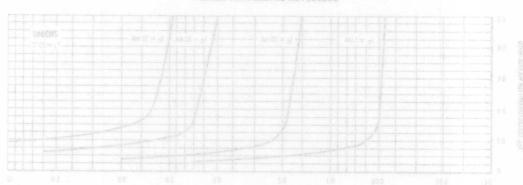




TEMPERATURE COEFFICIENTS



COLLECTOR SATURATION REGION

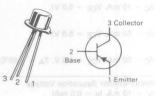


MAXIMUM RATINGS

MAXIMUM RATINGS	08			NABEL	CARPINE	
Rating		Symbol	2N3962 2N3965		2N3963	Unit
Collector-Emitter Voltage	000	VCEO	60	45	80	V
Collector-Base Voltage		VCBO	60	45	80	V
Emitter-Base Voltage	081	VEBO		6.0		V
Collector Current — Contin	uous	Ic		200		mA
Total Device Dissipation (a T _A = 25°C Derate above 25°C	08	P _D	IOV	0.36 2.06		Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C		P _D	ISIV	1.2 6.85		Watts mW/°C
Operating and Storage Jur Temperature Range	nction	TJ, T _{stg}		-65 to +2	00	°C

2N3965

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N3798 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Chara	cteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	and I				1016	beam! sug-
Collector-Emitter Breakdown Voltage (I _C = 5.0 mA)		2N3962, 2N3965	V(BR)CEO	60	mA, V _{CE} = 1	
		2N3963 2N3964	(8)	80	sback-Ratio nA, VEr = 1	oftage Fee (Ic = 1.0
Collector-Emitter Breakdown Voltage (IC = 10 µA) BBB BBB BBB	sių	2N3962, 2N3965 2N3963 2N3964	V(BR)CES	60 80 45	Current Gar Am. Vog = 1	Vdc n
Collector-Base Breakdown Voltage (I _C = 10 μA)	9141	2N3962, 2N3965 2N3963	V(BR)CBO	60 80		Vdc.
		2N3964		45	aonarti A Maria	mbA Juqtu
Emitter-Base Breakdown Voltage (I _C = 10 μA)		2N3884, 2N3885	V(BR)EBO	6.0	37	Vdc
Collector Cutoff Current (VCE = 50 V; 2N3964 = 40 V) (VCE = 70 V)		2N3965, 2N3962 2N3963	ICBO V a	0 V, 8W = 1	10 10	nAdc
Collector Cutoff Current (VCE = 50 V) (VCE = 70 V) (VCE = 40 V) (VCE = 50 V)		2N3962 2N3963 2N3964 2N3965	ICES SH 06	1 - We v	10 10 10 10	1 = 10 RB 10 = 20
Emitter Cutoff Current (VEB = 4.0 V)			IEBO AH E) V, 8W = 1	10 V A	nAdc
ON CHARACTERISTICS						
DC Current Gain(1) (I _C = 10 μA, V _{CE} = 5.0 V)		2N3962, 2N3963	h _{FE} 38 0	100		di 01
$(I_C = 100 \ \mu\text{A, V}_{CE} = 5.0 \ \text{V})$		2N3964, 2N3965 2N3962, 2N3963 2N3964, 2N3965	- A85 to 4	100 250	— —	Pulse Test
$(I_C = 1.0 \text{ mA, } V_{CE} = 5.0)$		2N3962, 2N3963 2N3964, 2N3965		100 250	450 600	
$(I_C = 10 \mu A, V_{CE} = 5.0, T_A = -55^{\circ}C)$		2N3962, 2N3963 2N3964, 2N3965		40 100	_	

(continued)

2N3962, 2N3963, 2N3964, 2N3965

Characteristic			Symbol	Min	Max	Unit
DC Current Gain(1) continued						
$(I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, T_A = 100^{\circ}\text{C})$		2N3962, 2N3963			600	
		2N3964, 2N3965		_	800	
CASE 22-03, STYLE 1					A RATINGS	NAXINIU
$(I_C = 1.0 \mu\text{A}, V_{CE} = 5.0 \text{V})$		2N3962, 2N3963	AND DESCRIPTION OF THE PARTY OF	60	-	
		2N3964, 2N3965	21/23/82	180	Workland?	
$(I_C = 10 \text{ mA}, V_{CE} = 5.0 \text{ V})$		2N3962, 2N3963	Symbol 2N3955	100	Rasing	
THE THE THE SECOND SECO		2N3964, 2N3965	OBOV	200	utter <u>Voltage</u>	nil notaalio
			VCBD 60		e voltage "	allegion-3a
$(I_C = 50 \text{ mA}, V_{CE} = 5.0 \text{ V})$		2N3962, 2N3963		90	Voltatie	mitter-Base
		2N3964, 2N3965	CEBA	180		
$(I_C = 50 \text{ mA}, V_{CE} = 5.0 \text{ V}, T_A = -55^{\circ}\text{C})$		2N3962, 2N3963	31	45	tano) — snah	ellector Cu
C CL		2N3964, 2N3965	69	90	Dissimation	to 750 late
Collector-Emitter Saturation Voltage	TIEVE	96.0	V _{CE(sat)}		WiSHA	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
(I _C = 10 mA, I _B = 0.5 mA)			CL(Sat)		0.25	dr ateraQ
$(I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA})(1)$			99	_	0.4	out Visio
Base-Emitter Saturation Voltage	38378379	2.1	V _{BE(sat)}		1-0-00	3 1 31 10
(I _C = 10 mA, I _B = 0.5 mA)			*DE(Sdl)		0.9	V
$(I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA})(1)$			eteT -L	metion	0.95	V
SMALL-SIGNAL CHARACTERISTICS					planet on	no equitor
Output Capacitance			C .		6.0	n.E
(V _{CB} = 5.0 V, f = 1.0 MHz)			Cobo		6.0	pF
		Chalon salw as to sa	10 A 20 O O O O	CONTRACTOR	N. CHARAC	013703.0
Input Capacitance			Cibo	3	15	pF
(VEB 0.0 V, 1 1.0 WHILE)	A Company of the Comp				-	15 AUR 23/
nput Impedance			hie		CTEMBTICS	kΩ
$(I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz})$		2N3962, 2N3963			base 17	allector Er
- 00	306	2N3964, 2N3965		6.0	20 (Am	0 = gb
Voltage Feedback Ratio			h _{re}	_	10	10-4
$(I_C = 1.0 \text{ mA}, V_{CE} = 5.0, f = 1.0 \text{ kHz})$	-	PRESERVE			-	
Small-Signal Current Gain			hfe		dolpsy8 rettic	nd retosile
$(I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz})$		2N3962, 2N3963		100	550	(0 = 3H
- 08		2N3964, 2N3965		250	700	_
Magnitude of Forward Current Transfer Ratio, Com	mon-Emit	er	hfe			
$(I_C = 0.5 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 20 \text{ MHz})$		2N3962, 2N3963		2.0	8.0	offerdor, 6 a
00	000	2N3964, 2N3965	3/22/3/3/3/	2.5	8.0	. 0 = 30
Output Admittance			hoe			μmhos
$(I_C = 1.0 \text{ mA}, V_{CE} = 5.0, f = 1.0 \text{ kHz})$		2N3962, 2N3963		5.0	40	
V(BB)EBQ 6.0 - Vdc		2N3964, 2N3965		5.0	50	NE ENGRICA
Noise Figure			NF			dB
$(I_C = 20 \text{ mA}, V_{CE} = 5.0 \text{ V}, BW = 15.7 \text{ kHz})$		2N3962, 2N3963		-	3	D registro
		2N3964, 2N3965		(V 0) =	2	Most appli
// 00 A W 50 W DW 45 W		0210000 0210000				- 30VI
$(I_C = 20 \mu A, V_{CE} = 5.0 \text{ V}, BW = 1.5 \text{ kHz},$		2N3962, 2N3963		_	3 10	
$f = 10 \text{ kHz}, R_S = 10 \text{ k}\Omega)$		2N3964, 2N3965			2	16 - 30V)
$(I_C = 20 \mu A, V_{CE} = 5.0 \text{ V}, BW = 150 \text{ Hz},$		2N3962, 2N3963			3	2000
1.C 25 Mr., *CE 0.0 *, D.*		2N3964, 2N3965	HE WAY	_	2	(Ves 56
$f = 1.0 \text{ kHz}, R_S = 10 \text{ k}\Omega$						
$f = 1.0 \text{ kHz}, R_S = 10 \text{ k}\Omega)$		2110001, 2110000	-		I washinds on to	
$f = 1.0 \text{ kHz}, R_S = 10 \text{ k}\Omega$ $(I_C = 20 \mu\text{A}, V_{CE} = 5.0 \text{ V}, BW = 15 \text{ Hz},$		2N3962, 2N3963		_	10	
					4	(VEB. 4
$(I_C = 20 \ \mu\text{A}, V_{CE} = 5.0 \ \text{V}, BW = 15 \ \text{Hz},$ $f = 100 \ \text{Hz}, R_S = 10 \ \text{k}\Omega)$		2N3962, 2N3963 2N3964, 2N3965		=	30178H31:	(VEB. 4
$(I_C = 20 \mu A, V_{CE} = 5.0 \text{ V}, BW = 15 \text{ Hz},$ f = 100 Hz, R _S = 10 kΩ) $(I_C = 20 \mu A, V_{CE} = 5.0 \text{ V}, BW = 2.0 \text{ Hz},$		2N3962, 2N3963		=	30178/H31.	(VEB 44) ON CHAPAR C Cummt
$\begin{split} &(\text{IC} = 20 \; \mu\text{A, V}_{\text{CE}} = 5.0 \; \text{V, BW} = 15 \; \text{Hz,} \\ &f = 100 \; \text{Hz, R}_{\text{S}} = 10 \; \text{k}\Omega) \\ &(\text{IC} = 20 \; \mu\text{A, V}_{\text{CE}} = 5.0 \; \text{V, BW} = 2.0 \; \text{Hz,} \\ &f = 10 \; \text{Hz, R}_{\text{S}} = 10 \; \text{k}\Omega) \end{split}$	100	2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965			30178/H31.	(VEB AND NO
$ \begin{split} &(I_{C}=20~\mu\text{A, V}_{CE}=5.0~\text{V, BW}=15~\text{Hz,} \\ &f=100~\text{Hz, R}_{S}=10~\text{k}\Omega) \\ &(I_{C}=20~\mu\text{A, V}_{CE}=5.0~\text{V, BW}=2.0~\text{Hz,} \\ &f=10~\text{Hz, R}_{S}=10~\text{k}\Omega) \end{split} $	281	2N3962, 2N3963 2N3964, 2N3965			30178/H31.	(VEB 44 ON CNAPRA IC Cum nt
(I _C = 20 μ A, V _{CE} = 5.0 V, BW = 15 Hz, f = 100 Hz, R _S = 10 $\kappa\Omega$) (I _C = 20 μ A, V _{CE} = 5.0 V, BW = 2.0 Hz, f = 10 Hz, R _S = 10 $\kappa\Omega$) 1) Pulse Test: PW \approx 300 μ s, Duty Cycle \approx 2%.		2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965		- (V)	8 mm	(Vgg 4 ON CNA RA IC Current (Ic = 10
(I _C = 20 μ A, V _{CE} = 5.0 V, BW = 15 Hz, f = 100 Hz, R _S = 10 kΩ) (I _C = 20 μ A, V _{CE} = 5.0 V, BW = 2.0 Hz, f = 10 Hz, R _S = 10 kΩ) Pulse Test: PW = 300 μ s, Duty Cycle = 2%.		2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965		(V:0.	30178/H31.	(Vgg 4 ON CNA RA IC Current (Ic = 10
(I _C = 20 μ A, V _{CE} = 5.0 V, BW = 15 Hz, f = 100 Hz, R _S = 10 k Ω) (I _C = 20 μ A, V _{CE} = 5.0 V, BW = 2.0 Hz, f = 10 Hz, R _S = 10 k Ω) 1) Pulse Test: PW \ll 300 μ s, Duty Cycle \ll 2%.		2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965		- (V 0.	8 mm	ON CHARAC SC Current Sc = 10
(I _C = 20 μA, V _{CE} = 5.0 V, BW = 15 Hz, f = 100 Hz, R _S = $10 \text{ k}\Omega$) (I _C = 20 μA, V _{CE} = 5.0 V, BW = 2.0 Hz, f = 10 Hz , R _S = $10 \text{ k}\Omega$)) Pulse Test: PW \leqslant 300 μs, Duty Cycle \leqslant 2%.		2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965			8 mm	(Vg = 100) (Ug = 100)
(I _C = 20 μ A, V _{CE} = 5.0 V, BW = 15 Hz, f = 100 Hz, R _S = 10 kΩ) (I _C = 20 μ A, V _{CE} = 5.0 V, BW = 2.0 Hz, f = 10 Hz, R _S = 10 kΩ) I) Pulse Test: PW = 300 μ s, Duty Cycle = 2%.		2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965			8 10112 8 2017 8 2017 8 2017 8 2017 8 2017	(VEB - 4 DN CNA RA (UC = 10 (UC = 10)
(I _C = 20 μ A, V _{CE} = 5.0 V, BW = 15 Hz, GBB f = 100 Hz, R _S = 10 kΩ) (I _C = 20 μ A, V _{CE} = 5.0 V, BW = 2.0 Hz, f = 10 Hz, R _S = 10 kΩ) 1) Pulse Test: PW \leq 300 μ s, Duty Cycle \leq 2%.		2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965 2N3964, 2N3965			A VCE = 5	00 = 1.0
(I _C = 20 μ A, V _{CE} = 5.0 V, BW = 15 Hz, GBB f = 100 Hz, R _S = 10 kΩ) (I _C = 20 μ A, V _{CE} = 5.0 V, BW = 2.0 Hz, f = 10 Hz, R _S = 10 kΩ) 1) Pulse Test: PW \leq 300 μ s, Duty Cycle \leq 2%.		2N3962, 2N3963 2N3964, 2N3965 2N3964, 2N3965 2N3964, 2N3965	10		8 10112 8 2017 8 2017 8 2017 8 2017 8 2017	$V_{\rm EB} = 1.0$ $V_{\rm C} = 10$ $V_{\rm C} = 100$

2N4013 2N4014

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





SWITCHING TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Oh O Rating	Symbol	2N4013	2N4014	Unit
Collector-Emitter Voltage	VCEO	30	50	Vdc
Collector-Base Voltage	VCBO	50	80	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current — Continuous — Peak	lc	1.0 POMPS 2.0 POMPS		Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	100	0.5 28.6	
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.4 6.8		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

stic		Symbol	Min	Тур	Max	Unit
7			(8)tar.	width Prad	bas8 — na	D-triumic D
0000	2N4014 2N4013	V(BR)CEO	50 30	r = 1.0 =	gl a <u>h</u> V 01	Vdc
Ciba	2N4014 2N4013	V(BR)CES	80 50	r = <u>T</u> 0 =		Vdc qed and a
		V(BR)CBO		TERISTICS	MHAHO DA	Vdc
	2N4014 2N4013	Value = 2.6	80 50	50V=-		mif yelad
1 - 2		V(BR)EBO	6.0	up/Al_	_	Vdc
		Ain ODE = N	abV of a	how I	am	Sucrage T
li .	2N4014	СВО	182 = 50 res 8_10)		1.7	μAdc
	2N4014			DOM	120 120	I nO-mcI
1967	2N4014 2N4013			0.15 0.15	10 10	μAdc
	Coton Coton Coton United the Coton United the Coton United the Coton	2N4014 2N4013 2N4014 2N4013 2N4014 2N4013 2N4014 2N4013 2N4014 2N4013 2N4014 2N4013	2N4014 2N4013 V(BR)CEO 2N4014 2N4013 V(BR)CES 2N4014 2N4013 V(BR)CBO 2N4014 2N4013 V(BR)EBO ICBO 2N4014 2N4013 2N4014 2N4013 2N4014 2N4013 1CES	2N4014 2N4013	2N4014	2N4014

ON CHARACTERISTICS(1)

DC Current Gain		hFE			dentity of	hn —n (5)
(I _C = 10 mAdc, V _{CE} = 1.0 Vdc)		WITTER - 1 18	30	_	_	
(I _C = 100 mAdc, V _{CE} = 1.0 Vdc)			60	46	150	
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^{\circ}C)$			30	-	_	
(I _C = 300 mAdc, V _{CE} = 1.0 Vdc)			40	_		
(I _C = 500 mAdc, V _{CE} = 1.0 Vdc)			35	_	_	
$(I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^{\circ}C)$			20	_	-	
(I _C = 800 mAdc, V _{CE} = 2.0 Vdc)	2N4014		20			
	2N4013	11-20001	25	_	-	
(I _C = 1.0 Adc, V _{CF} = 5.0 Vdc)	2N4014	HE DONDING WELL	25			
	2N4013		30	_		

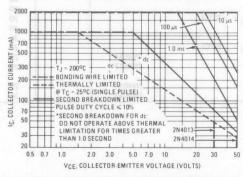
(continued)

	Characteristic			Symbol	Min	Тур	Max	Unit
Collector-Emitter Satura	tion Voltage 1.0 mAdc)		2N4014 2N4013	V _{CE} (sat)	=	0.17 0.17	0.25 0.25	Vdc
$(I_C = 100 \text{ mAdc}, I_B =$			2N4014 2N4013		_	0.19 0.19	0.26	JARIXAR
(I _C = 300 mAdc, I _B =	30 mAdc)		2N4014	Symbol 2N	_	0.25	0.40	
			2N4013	Vero	_	0.25	0.32	l-notoeli
(I _C = 500 mAdc, I _B =	50 mAdc)		2N4014	Усво		0.30	0.52	Hectorell
			2N4013	083V	-	0.30	0.42	16 1811 i
(I _C = 800 mAdc, I _B =	80 mAdc)		2N4014 2N4013	DI	=	0.43 0.43	0.80 0.65	lector (
(I _C = 1.0 Adc, I _B = 1			2N4014	Qq .	ores _	0.55	0,95	tel Devi Derate a
200721216617	CHARLELINE .	C2542	2N4013	- 69	9/95	0.55	0.75	lugG let
Base-Emitter Saturation ($I_C = 10 \text{ mAdc}$, $I_B = (I_C = 100 \text{ mAdc}$, $I_B = 100 \text{ mAdc}$)	1.0 mAdc) = 10 mAdc)			VBE(sat)	=	notbrat a	0.76 0.86	erading
(I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 800 mAdc, I _B = 80 mAdc)					0.8		1.1 1.1 1.5	RT01
(I _C = 1.0 Adc, I _B = 1 SMALL-SIGNAL CHARA			therwise noted		TICS-TA Chernsterk	Cartan Orto	1./	1011 0734
Current-Gain — Bandwi	A STATE OF THE PARTY OF THE PAR			fT	300		TEIRE DA	MH.
Output Capacitance (V _{CB} = 10 Vdc, I _E =	03		2N4014 2N4013	C _{obo}		10 =	10	pF
Input Capacitance (VEB = 0.5 Vdc, IC =	0, f = 1.0 MHz)		2N4014 2N4013	C _{ibo}	-	40 = 3	55 S	pF
SWITCHING CHARACT	ERISTICS	v 1.			- 61	lown Voltag	ase Breets	F-rotoull
Delay Time	(V _{CC} = 30 Vdc, V _{BE(off)} =	3.8 Vdc	2NAD14	t _d	_	5.0	10	ns
Rise Time	IC = 500 mAdc, IB1 = 50 m (Figures 8, 10)		28/40013	t _r	_	15 IgsdoV ow	30	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 500 m	Adc,	2N4014	t _S	_	30	50	ns
Fall Time	I _{B1} = I _{B2} = 50 mAdc) (Figures 9, 10)		2N4013	tf		20 25	25 30	ns
Turn-On Time	(V _{CC} = 30 Vdc, V _{BE(off)} = I _C = 500 mAdc, I _{B1} = 50 n (Figures 8, 10)	3.8 Vdc nAdc)	ZNAD1A ZNAD1A	^t on	190°C)	= ,20 o = = AT ,0 =	35/ 08	= ns
Turn-Off Time	(V _{CC} = 30 Vdc, I _C = 500 m I _{B1} = I _{B2} = 50 mAdc) (Figures 9, 10)	nAdc,	2N4014 2N4013	toff	-	-	60 or	440

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 1.0%.

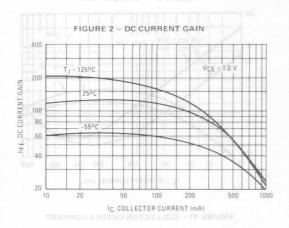
(2) $f_T = |hfe| \cdot f_{test}$.

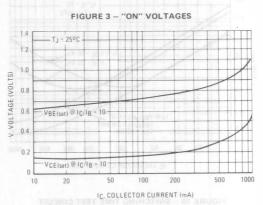
FIGURE 1 - ACTIVE-REGION SAFE OPERATING AREA

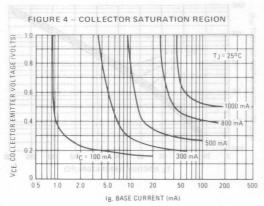


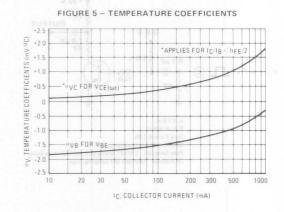
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

MIT TO MRUT - B BRUDIS TYPICAL DC CHARACTERISTICS SMIT NO MRUT - B BRUDIS

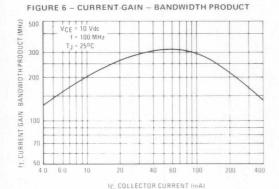








TYPICAL DYNAMIC CHARACTERISTICS



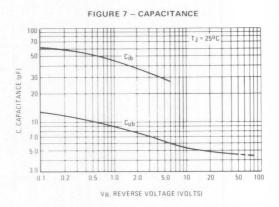
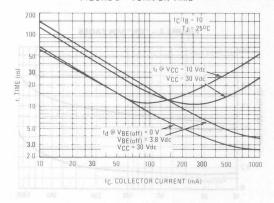


FIGURE 8 - TURN-ON TIME 20172/02/03/2019/03/1907 FIGURE 9 - TURN-OFF TIME



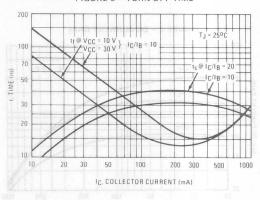


FIGURE 10 - SWITCHING TIME TEST CIRCUIT

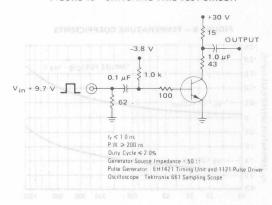
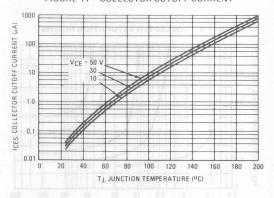
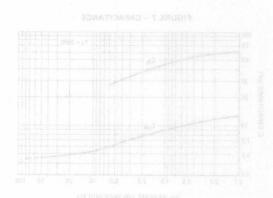
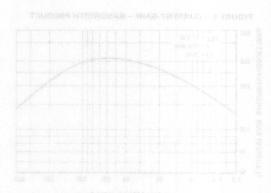


FIGURE 11 - COLLECTOR CUTOFF CURRENT







MAXIMUM RATINGS

Rating	Symbol	2N4026/28 2N4030/32	2N4027/29 2N4031/33	Unit
Collector-Emitter Voltage(1)	VCEO	60	80	Vdc
Collector-Base Voltage	Vсво	60	80	Vdc
Emitter-Base Voltage	VEBO	5.0	5.0	Vdc
0.00		2N4026- 2N4029	2N4030- 2N4033	2844
Collector Current — Continuous	IC	1.0	1.0	Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	.5 2.85	1.25 7.15	W mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	2.0 11.4	7.0 40	W mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	0 +200	°C
Lead or Terminal Temperature(2)	TL	+	300	°C

- (1) Applicable 0 to 10 mA
- (2) Measured at a distance not less than 1/16" from seated surface (or case) for 60 Sec.

THERMAL CHARACTERISTICS

THE MINE OF A THOUGH				
Characteristic	Symbol	TO-18	TO-39	Unit
Thermal Resistance, Junction to Case	$R_{\theta}JC$	40	20	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	280	140	°C/W

2N4026 thru 2N4029





2N4030 thru 2N4033

CASE 79-02, STYLE 1 TO-39 (TO-205AD) JAN, JTX, TXV AVAILABLE IN GENERAL PURPOSE



TRANSISTOR
PNP SILICON

ELECTRICAL CHARACTERISTICS	(TA =	25°C unless	otherwise	noted.)
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Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		.4F0	uty Cycle 1.	G ,ag 008 =	#BW 62
Collector-Emitter Breakdown Voltage $(I_C = 10 \text{ mA})$	2N4026,28,30,32 2N4027,29,31,33	V(BR)CEO	60 80	=	V
Collector-Base Breakdown Voltage (IC = 10 μ A)	2N4026,28,30,32 2N4027,29,31,33	V(BR)CBO	60 80	=	V
Emitter-Base Breakdown Voltage (I _E = 10 μA)		V(BR)EBO	5.0		V
Collector Cutoff Current (V _{CB} = 50 V) (V _{CB} = 60 V) (V _{CB} = 50 V, T _A = 150°C) (V _{CB} = 60 V, T _A = 150°C)	2N4026,28,30,32 2N4027,29,31,33 2N4026,28,30,32 2N4027,29,31,33	ІСВО	=	50 50 50 50	nA μA
Emitter Cutoff Current (V _{EB} = 5.0 V)		IEBO		10	μΑ
ON CHARACTERISTICS					
DC Current Gain (I _C = 100 mA, V_{CE} = 5.0 V, @ -55° C)	2N4026,27,30,31 2N4028,29,32,33	hFE	15 40	=	-
$(I_C = 100 \ \mu A, V_{CE} = 5.0 \ V)$	2N4026,27,30,31 2N4028,29,32,33		30 75	=	
$(I_C = 100 \text{ mA}, V_{CE} = 5.0 \text{ V})$	2N4026,27,30,31 2N4028,29,32,33		40 100	120 300	
$(I_C = 500 \text{ mA}, V_{CE} = 5.0 \text{ V})$	2N4026,27,30,31 2N4028,29,32,33		25 70	= =	
$(I_C = 1.0 \text{ A, V}_{CE} = 5.0 \text{ V})$	2N4026,30 2N4027,31 2N4028,32 2N4029,33		15 10 40 25	Ξ	

ELECTRICA	L CHARACT	ERISTICS	$(T_A = 25^{\circ}C unle$	ess otherwise noted.)			Rating	
rad il		Cl	aracteristic	abV 68 9	- Jimes.	Min	Max	Unit
$(I_C = 150 \text{ r})$	tter Saturatio nA, IB = 15 n nA, IB = 50 n	nA)			VCE(sat)	_	0.15 0.50	ollecy v-Bas mitter Base
$(I_C = 1.0 \text{ A})$, I _B = 100 m	A)	er-or	2N4026,28,30,32	\$4/15 53.65	_	1.0	
	Saturation Vo nA, I _B = 15 r			55A 0.1 0.	Enon	0.9	ollec ^V or Cun	
Base-Emitter On Voltage (IC \neq 1.0 A, V _{CE} $=$ 1.0 V) (IC $=$ 500 mA, V _{CE} $=$ 0.5 V)				2N4026,28,30,32		0°85 = 0T	1.2	Dere e abo
	IAL CHARACT		MC	Unwin 94 P.	II I		203.0	ous sisisO
Output Capac		To eng	CASE 7	C _{obo}		20	pF	
nput Capacit (V _{EB} = 0.5	V, f = 1.0 M	Hz)	JAN	2) 1 00E+	C _{ibo}	(XISTU)	110 Am Of or	pF side siggA
Small Signal (I _C = 50 m	Current Gain A, V _{CE} = 10	V, f = 100	MHz)	1/402 (of case) for 60 Sec.	h _{fe}	1.0	4.0	JAMBSHI L
SWITCHING	CHARACTERI	STICS	ART	sint! es.or st-o	T Todowell T		Characterist	
Storage Time (I _C = 500 r	mA, I _{B1} = I _{B2}			49 20 °C W	Digits	ens J o t no	350	ns nen
Turn-On Time (I _C = 500 r	e nA, I _{B1} = 50	mA)		40.3 507 505	ton	MINUMENT COLUMN	100	ns
	mA, I _{B1} = I _{B2}			ottrerwise noted.)	A protection	T) 201 <u>7</u> 2183 HHO	50	ns
Pulse Width	$=$ 300 μ s, D	uty Cycle 1	.0%.					
		08						
V								
				2N4028,30 2N4027,31 2N4028,32 2N4028,33				

Rating	Symbol	2N4036	2N4037	Unit
Collector-Emitter Voltage	VCEO	65	40 (sus)(1)	Vdc
Collector-Base Voltage	VCBO	90	60	Vdc
Emitter-Base Voltage	VEBO	7.0	7.0	Vdc
Base Current	IB	0	.5	Adc
Collector Current — Continuous	Ic	1	.0	Adc
Continuous Power Dissipation at or Below T _C = 25°C Linear Derating Factor	PD	5.0 28.6	1.0 5.72	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	+ 200	°C 25
Lead Temperature 1/16" from Case for 10 Seconds	TL	2	30	°C

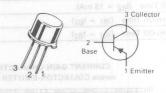
THERMAL CHARACTERISTICS

Characteristic	Symbol	2N4036	2N4037	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	25	8 -	°C/W

(1) Must not be tested on a curve tracer.

2N4037

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



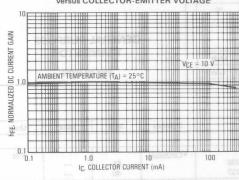
GENERAL PURPOSE TRANSISTOR

PNP SILICON

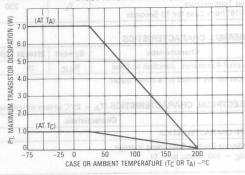
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					-
Collector-Emitter Sustaining Voltage (IC = 100 mAdc, IB = 0)	2N4036 2N4037	VCEO(sus)	65 40	1.1 3.2(Vdc
Collector-Base Breakdown Voltage COTARUTAE JACIEST (IC = 0.1 mA dc)	2N4037	V(BR)CBO	60 60 HO		Vdc
Collector Cutoff Current (V _{CE} = 85 V, V _{BE} = 1.5 V) (V _{CE} = 30 V, V _{BE} = 1.5 V, T _C = 150°C)	2N4036	ICEX		100 0.1	mAdc
Collector Cutoff Current (VCB = 90 V, IE = 0) (VCB = 60 V, IE = 0)	2N4036 2N4037	ІСВО		100 0.25	μAdc
Emitter Cutoff Current (VBE = 7.0 Vdc, I _C = 0) (VBE = 5.0 Vdc, I _C = 0)	2N4036 2N4037	IEBO		10.0 1.0	μAdc
ON CHARACTERISTICS					
DC Current Gain (IC = 150 mAdc, V _{CE} = 2.0 V) (IC = 0.1 mAdc, V _{CE} = 10 V) (IC = 1.0 mAdc, V _{CE} = 10 V)	2N4036 2N4036 2N4037	hFE hFE	20 20 15	200 — —	P-111
(I _C = 150 mAdc, V _{CE} = 10 V) HO STAR MUMIXAM	2N4036 2N4037		40 50	140 250	NASAL.
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ V})$	2N4036	CHOOL CO. BUT	20		
Collector-Emitter Saturation Voltage (IC = 150 mA, IB = 15 mA)	2N4036 2N4037	VCE(sat)	50 1985 – (AT) 180	0.65 1.4	97 V 97 I
Base-Emitter Saturation Voltage (I _C = 150 mA, I _B = 15 mA)	2N4036	VBE(sat)		1.4	V
Base-Emitter On Voltage (IC = 150 mA, VCE = 10 V)	2N4037	V _{BE(on)}		1.5	V
SMALL-SIGNAL CHARACTERISTICS VON - XAV 0307					111.3
Collector-Base Capacitance (VCB = 10 V, f = 1.0 MHz)	2N4037	C _{cb}		30	pF
Current Gain — High Frequency (IC = 50 mA, V _{CE} = 10 V, f = 20 MHz)	2N4036	h _{fe}	3.0	IMMI	Ш

Characteristic		Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS	11112081				a Character
Rise Time (I _{B1} = 15 mA)	2N4036	080 t _r	_	70	ns
Storage Time (I _{B2} = 15 mA)	2N4036	t _S		600	ns
Fall Time (I _{B2} = 15 mA)	2N4036	tf	_	100	ns
Turn-On Time (I _{B1} = I _{B2})	2N4036	ton	ellot	110	ns
Turn-Off Time (IB1 = IB2)	2N4036	toff		700	ns ns

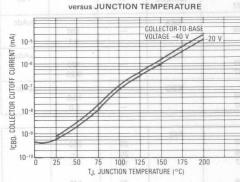




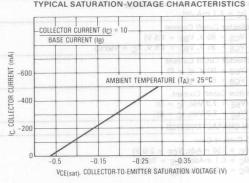
DISSIPATION DERATING CURVE



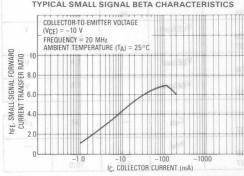
TYPICAL COLLECTOR-CUTOFF CURRENT



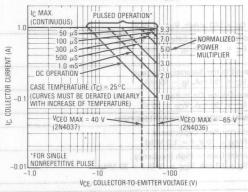
TYPICAL SATURATION-VOLTAGE CHARACTERISTICS



TYPICAL SMALL SIGNAL BETA CHARACTERISTICS



MAXIMUM SAFE OPERATING AREAS (SOA)



2N4208 2N4209

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





SWITCHING TRANSISTOR

PNP SILICON

Refer to MM4257 for graphs.

MAXIMUM RATINGS

Rating	Symbol	2N4208	2N4209	Unit
Collector-Emitter Voltage	VCEO	12	15	Vdc
Collector-Base Voltage	VCBO	12	15	Vdc
Emitter-Base Voltage	VEBO	4	.5	Vdc
Collector Current — Continuous	lc d	200		mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	P _D No	1	0.36 2.06	
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1 6	.2 .9	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	+ 200	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic

OFF CHARACTERISTICS

Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS	viinu o	Lestrapolates	adi dantwe	is vonsuce	ed as the	nitab ser
Collector-Emitter Breakdown Voltage(1) $(I_C = 3.0 \text{ mAdc}, I_B = 0)$	2N4208 2N4209	V(BR)CEO	12 15		=	Vdc
Collector-Emitter Breakdown Voltage $(I_C = 100 \mu Adc, V_{BE} = 0)$	2N4208 2N4209	V(BR)CES	12 15	=	=	Vdc
Collector-Base Breakdown Voltage $(I_C = 100 \mu Adc, I_E = 0)$	2N4208 2N4209	V(BR)CBO	12 15	=	=	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)		V(BR)EBO	4.5	5.9	-	Vdc
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	2N4208 2N4209 2N4208 2N4209	ICES	=	=	10 10 5.0 5.0	nAdc μAdc
Base Current $(V_{CE}=6.0\ \text{Vdc},\ V_{BE}=0)$ $(V_{CE}=8.0\ \text{Vdc},\ V_{BE}=0)$	2N4208 2N4209	IB	Ξ	=	1.0 1.0	nAdc

ON CHARACTERISTICS

DC Current Gain		hFF	3 1	TO PAGE	6-1-4 TE	_
$(I_C = 1.0 \text{ mAdc}, V_{CF} = 0.5 \text{ Vdc})$	2N4208		15	_		
. C	2N4209		35	-	, N <u>-</u>	
(I _C = 10 mAdc, V _{CF} = 0.3 Vdc)	2N4208		30		100	
(IC = 10 MAde, VCE = 0.3 Vde)	2N4208 2N4209		50		120 120	
(I _C = 10 mAdc, V _{CF} = 0.3 Vdc, T _A = -55°C)	2N4208		12		. v 1	
ile To finado, vee a sis vas, rg a sis si	2N4209		20	-		
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})(1)$	2N4208		30			
OL OL	2N4209		40	_	- 1	
Collector-Emitter Saturation Voltage		V _{CE} (sat)			(Project	Vdc
$(I_C = 1.0 \text{ mAdc}, I_B = 0.1 \text{ mAdc})$	2N4208	(/	_	_	0.13	
	2N4209		_	-	0.15	
$(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$	2N4208			_	0.15	
	2N4209		_	-	0.18	
$(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})(1)$	2N4208		_		0.5	
	2N4209		_	-	0.6	
Base-Emitter Saturation Voltage		V _{BE(sat)}				Vdc
(I _C = 1.0 mAdc, I _B = 0.1 mAdc)		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	_	0.7	0.8	
$(I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc})$			0.75	0.86	0.90	
$(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})(1)$			_	1.1	1.5	

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

	Characteristic			Symbol	Min	Тур	Max	Unit
SMALL-SIGNAL CHARAC	CTERISTICS							
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)			2N4208 2N4209	fΤ	700 850	1000 1100	=	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 140 kHz)				C _{obo}	-	2.0	3.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 140 kHz)		tinti	eosaws eo	Cibo	-	2.0	3.5	pF
SWITCHING CHARACTE	RISTICS					ap	nitter Valte	a 3-notaello
Turn-On Time				ton		10	15 98	a ns
Delay Time	$(V_{CC} = 1.5 \text{ Vdc}, V_{BE} = 0.00)$ $I_{C} = 10 \text{ mAdc}, I_{B1} = 1.00$			tdogaV	-	5.0	10 V	ns ns
Rise Time	(= 10 m/de, 181 = 1.0	mAde		tr		5.0	15	ns
Turn-Off Time	(V _{CC} = 1.5 Vdc,	neW 3°Wm	2N4208 2N4209	toff a9	25 0	12 16	15 20	e e e e e e
Storage Time	$I_C = 10 \text{ mAdc},$ $I_{B1} = I_{B2} = 1.0 \text{ mAdc})$		2N4208 2N4209	t _s dq		12 17	15 20	Decate at
Fall Time MOOLI			2N4208 2N4209	- tfieT d.T	-	6.0 8.0	55 10 bn	ga ns aq
Storage Time (I _C ≈ 10 mAdc, I _{B1} ≈ 1	10 mAdc, I _{B2} ≈ 10 mAdc)		2N4208 2N4209	t _S	ICS TA	ACT <u>E</u> RIST	15 JA 20	ns DISTOBLE

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

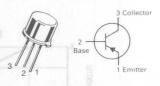
			ON CHARACTERISTICS
		2N4208 2N4209	

⁽²⁾ f_T is defined as the frequency at which |h_{fe}| extrapolates to unity.

Collector-Emitter Voltage		VCEO	40	60	80	Vdc
Collector-Base Voltage		VCBO	40	60	80	Vdc
Emitter-Base Voltage		VEBO		7.0		Vdc
Base Current		IB		0.2		Vdc
Collector Current — Continuous		lc		1.0 3.0*		Adc
Total Device Dissipation 25°C Derate above 25°C	(a T _A =	PD	Year ar	1.0 5.7		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C		PD	6.0			Watts mW/°C
Operating and Storage Junction Temperature Range		T _J , T _{stg}		-65 to +200		°C

2N4236

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	29	°C/W

GENERAL PURPOSE TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

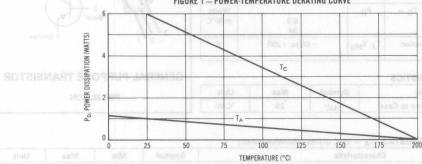
Characteristic	COST ENLICATED NICE	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	by Figure 2.	betapibni eta zev	afa Area Cum	S	
Collector-Emitter Sustaining Voltage(1) $(I_C = 100 \text{ mAdc}, I_B = 0)$	2N4234	VCEO(sus)	40 60 80	=	Vdc
Collector Cutoff Current (V _{CE} = 30 Vdc, I _B = 0) (V _{CE} = 40 Vdc, I _B = 0) (V _{CE} = 60 Vdc, I _B = 0)	2N4234 2N4235 2N4236	ICEO	neums 2	1.0 1.0 1.0	mAdc
Collector Cutoff Current (VCE = 40 Vdc, VBE = 1.5 Vdc) (VCE = 60 Vdc, VBE = 1.5 Vdc) (VCE = 80 Vdc, VBE = 1.5 Vdc) (VCE = 30 Vdc, VBE = 1.5 Vdc, TC = 150°C) (VCE = 40 Vdc, VBE = 1.5 Vdc, TC = 150°C) (VCE = 60 Vdc, VBE = 1.5 Vdc, TC = 150°C)	2N4234 2N4235 2N4236 2N4234 2N4235 2N4236	ICEX		0.1 0.1 0.1 1.0 1.0	mAdd
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 80 Vdc, I _E = 0)	2N4234 2N4235 2N4236	ICBO	PREAKDOWN EIN MIATION AT T _C TER DISSIPATION E ARDVE I _C = 1	0.1 0.1 0.1	mAdc
Emitter Cutoff Current (VBE = 7 Vdc, IC = 0)	(1891 PRP 214236	IEBO		0.5	mAdc
ON CHARACTERISTICS	810785				
DC Current Gain(1) (IC = 100 mAdc, VCE = 1.0 Vdc) (IC = 250 mAdc, VCE = 1.0 Vdc) (IC = 500 mAdc, VCE = 1.0 Vdc) (IC = 1.0 Adc, VCE = 1.0 Vdc)	02 06 05 (2[J0VI 3047]	OV SETTING HOTOSUDO	40 30 20 10	150 —	0.1
Collector-Emitter Saturation Voltage(1) (I _C = 1.0 Adc, I _B = 125 mAdc)		VCE(sat)	_	0.6	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 1.0 Adc, I _B = 100 mAdc)		V _{BE(sat)}	-	1.5	Vdc
Base-Emitter On Voltage (I _C = 250 mAdc, V _{CE} = 1.0 Vdc)		VBE	-	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 100 mAdc, V _{CE} = 10 Vdc, f = 1.0 MHz)		f _T	3.0		MHz

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic				Symbol	Min	Max	Unit
Output Capacitance	312/4	0.0	00	Cobo		100	ηF
(V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	Vds	98	08	080V		se Voltage	s8-massl
Small-Signal Current Gain				h _{fe}	25	agattoV i	es6 and
$(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$				al			rem Der

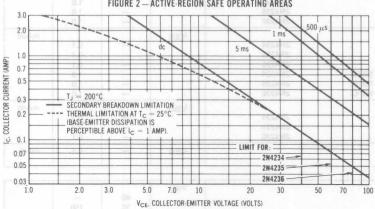
(1) Pulse Test: PW ≤ 300 µs. Duty Cycle ≤ 2.0%. *Indicates Data in addition to JEDEC Requirements.





Safe Area Curves are indicated by Figure 2. All limits are applicable and must be observed.

FIGURE 2 - ACTIVE-REGION SAFE OPERATING AREAS

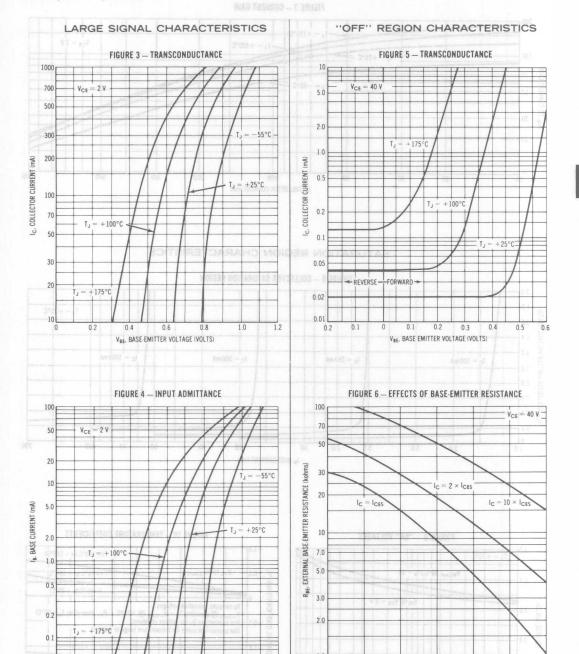


The Safe Operating Area Curves indicate Ic — V_{CE} limits below which the device will not enter secondary breakdown. Collector load lines for specific circuits must fall within the applicable Safe Area to avoid causing a catastrophic failure. To insure operation below the maximum TJ, power-temperature derating must be observed for both steady state and pulse power conditions.

150

T_J, JUNCTION TEMPERATURE (°C)

175



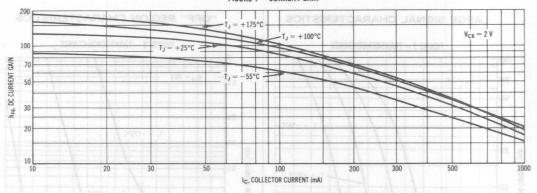
1.0

0.8

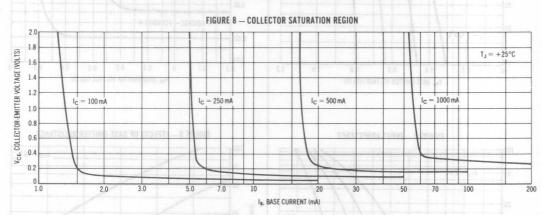
0.6

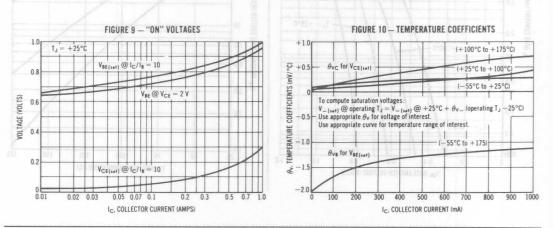
VBE. BASE-EMITTER VOLTAGE (VOLTS)

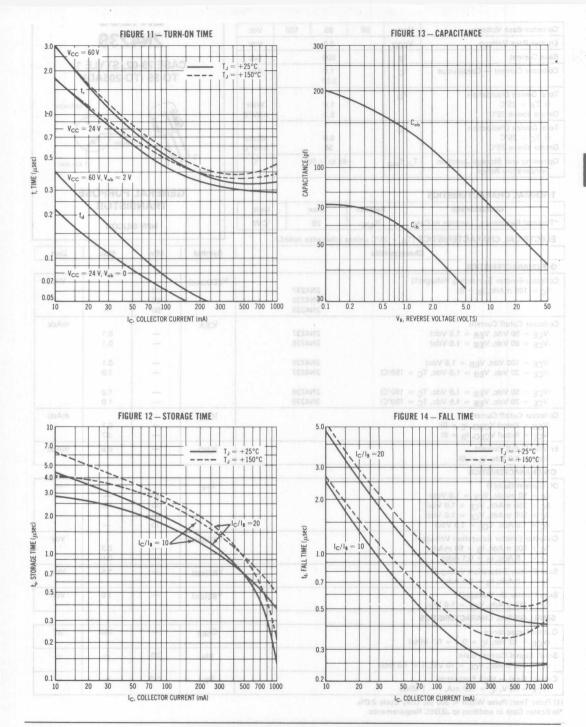




SATURATION REGION CHARACTERISTICS







MAXIMUM RATINGS					EM B
Rating	Symbol	2N4237	2N4238	2N4239	Unit
Collector-Emitter Voltage	VCEO	40	60	80	Vdc
Collector-Base Voltage	VCBO	50	80	100	Vdc
Emitter-Base Voltage	VEBO		6.0		Vdc
Base Current	IB		500		Vdc
Collector Current — Continuous	lc	1.0 3.0*		Adc	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.3		Watt mW/°C	
Total Device Dissipation (i) T _C = 25°C Derate above 25°C	PD	6.0 34		Watts mW/°0	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C	

2N4237 2N4238 2N4239

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

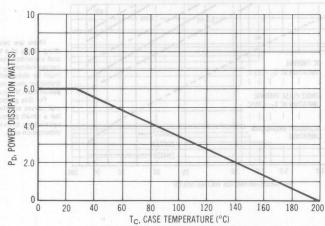
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
*Thermal Resistance, Junction to Case	R _O JC	29	°C/W

ELECTRICAL CHARACTERISTICS (T _A = 25°C unless	0 1 1		T		
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage(1) (IC = 100 mAdc, IB = 0)	2N4237 2N4238	VCEO(sus)	40 60		Vdc
0.2 0.5 0.0 2.0 5.0 10 20 59	2N4239	000 000 000	80	E 00 05	01
Collector Cutoff Current (V _{CE} = 50 Vdc, V _{EB} = 1.5 Vdc) (V _{CE} = 80 Vdc, V _{EB} = 1.5 Vdc)	2N4237 2N4238	ICEX	00 R91031,000 	0.1 0.1	mAdc
$(V_{CE} = 100 \text{ Vdc}, V_{EB} = 1.5 \text{ Vdc})$ $(V_{CE} = 30 \text{ Vdc}, V_{EB} = 1.5 \text{ Vdc}, T_{C} = 150^{\circ}\text{C})$	2N4239 2N4237		=	0.1 1.0	
(V _{CE} = 50 Vdc, V _{EB} = 1.5 Vdc, T _C = 150°C) (V _{CE} = 70 Vdc, V _{EB} = 1.5 Vdc, T _C = 150°C)	2N4238 2N4239		=	1.0 1.0	
Collector Cutoff Current ($V_{CB} = Rated V_{CBO}$, $I_{E} = 0$) ($V_{CF} = Rated V_{CFO}$, $I_{B} = 0$)		ICBO 304	RE 12 - \$101	0.1	mAdc
Emitter Cutoff Current (VEB = 6.0 Vdc, IC = 0)		IEBO		0.5	mAdd
ON CHARACTERISTICS	10.0				200
DC Current Gain(1) (I _C = 50 mAdc, V _{CE} = 1.0 Vdc) (I _C = 250 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 Adc, V _{CE} = 1.0 Vdc)	Z = = = = = = = = = = = = = = = = = = =	hFE	30 30 30 15	150 —	0
Collector-Emitter Saturation Voltage(1) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 0.1 Adc)	3/10 ¹ (3) E	VCE(sat)		0.3	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 1.0 Adc, I _B = 0.1 Adc)	二。	V _{BE(sat)}		1.5	Vdc
Base-Emitter On Voltage(1) (I _C = 250 mAdc, V _{CE} = 1.0 Vdc)	20 14/	V _{BE(on)}		1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	177				
Output Capacitance (V _{CB} = 10 Vdc, I _C = 0, f = 0.1 MHz)		C _{obo}		100	pF
Small Signal Current Gain (I _C = 100 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	1 2.9	h _{fe}	30		-
Current Gain — High Frequency (VCE = 10 V, IC = 100 mA, f = 1 MHz)	01 0001 005	h _{fe}	1.0	0E 0S	er er

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle 2.0%. *Indicates Data in addition to JEDEC Requirements.





Safe Area Curves are indicated by Figure 5. All limits are applicable and must be observed.

SWITCHING CHARACTERISTICS

FIGURE 2 - SWITCHING TIME EQUIVALENT CIRCUIT

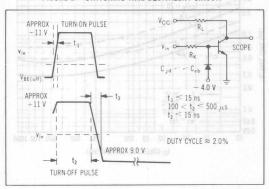
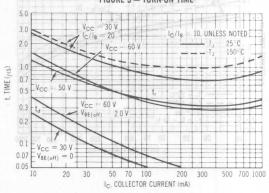
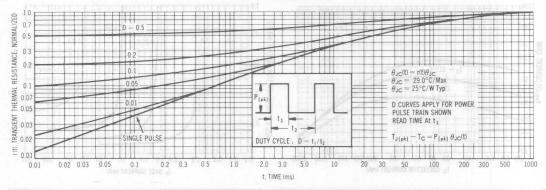


FIGURE 3 - TURN-ON TIME

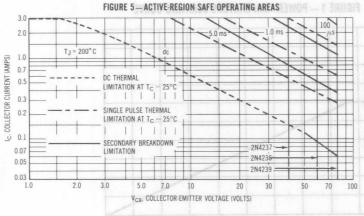


MOJOBB ROTTASUTAZ ROTTOLLIGO — © BRAGIN FIGURE 4 — THERMAL RESPONSE



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

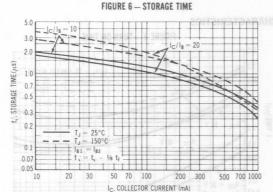


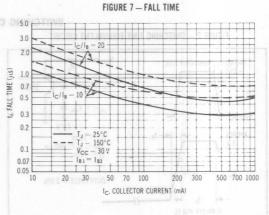


There are two limitations on the power handling ability of a transistor: junction temperature and secondary breakdown. Safe operating area curves indicate I_c—V_{CE} limits of the transistor that must be observed for reliable operation: i.e., the transistor must not be subjected to greater dissipation that the curves indicate the properation of the prop

pation than the curves indicate.

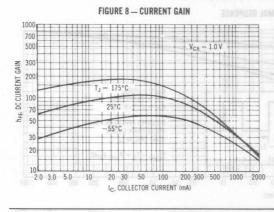
For this particular transistor family, the thermal curves are the limiting design values, except for a small portion of the dc curve. The pulse secondary breakdown curves are shown for information only.

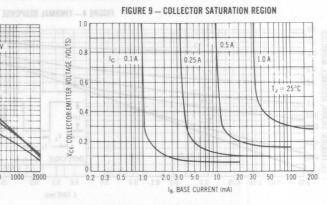




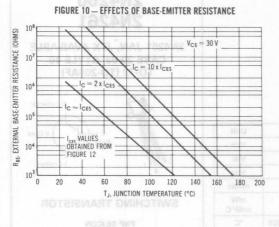
TYPICAL DC CHARACTERISTICS

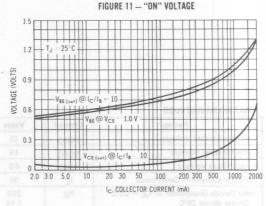
Safe Area Curves are indicated by Figure 5. All limits are applicable

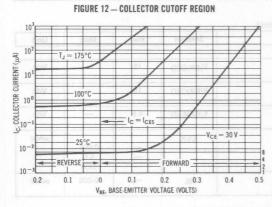


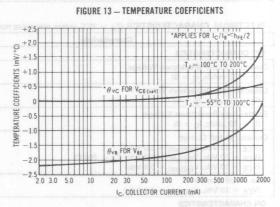








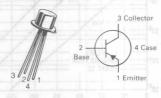






2N4260 2N4261

2N4261 JAN, JTX AVAILABLE CASE 20-03, STYLE 10 TO-72 (TO-206AF)



SWITCHING TRANSISTOR

PNP SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit			
Collector-Emitter Voltage	VCEO	50 15	Vdc			
Collector-Base Voltage	V _{CBO}	15	Vdc			
Emitter-Base Voltage	VEBO	4.5	Vdc			
Collector Current — Continuous	IC	30	mAdc			
Total Device Dissipation $(a T_A = 25^{\circ}C)$ Derate above 25°C	PD	200 1.14	mW mW/°C			
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C			

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

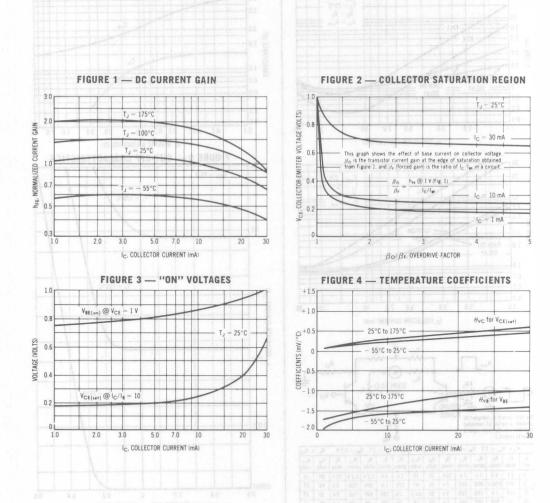
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			2001	9
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IE = 0)	V(BR)CEO	15	-	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	15	- 7 001	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V _{(BR)EBO}	4.5	-	Vdc
Collector Cutoff Current (VCE = 10 Vdc, VBE(off) = 2.0 Vdc) (VCE = 10 Vdc, VBE(off) = 2.0 Vdc, T _A = 150°C) (VCE = 10 Vdc, VEB(on) = 0.4 Vdc)	ICEX		0.005 5.0 0.05	μAdc
Base Cutoff Current (VCE = 10 Vdc, VBE(off) = 2.0 Vdc)	1 IBL 11	—4,A Lida sethiadori	0.005	μAdc
ON CHARACTERISTICS				
DC Current Gain (IC = 1.0 mAdc, V_{CE} = 1.0 Vdc) (IC = 10 mAdc, V_{CE} = 1.0 Vdc) (IC = 30 mAdc, V_{CE} = 2.0 Vdc)	hFE	25 30 20	 150 	-
Collector-Emitter Saturation Voltage (IC = 1.0 mAdc, IB = 0.1 mAdc) (IC = 10 mAdc, IB = 1.0 mAdc)	VCE(sat)	=	0.15 0.35	Vdc
Base-Emitter On Voltage ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	V _{BE(on)}	= 1	0.8 1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS			78157	
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 4.0 Vdc, f = 100 MHz) 2N4260 2N4261	fT	1200 1500	1=	MHz
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz})$ 2N4260 2N4261		1600 2000	=	
Output Capacitance ($V_{CB} = 4.0 \text{ Vdc}$, $I_E = 0$, $f = 100 \text{ kHz}$)	C _{obo}	-	2.5	pF
Input Capacitance $(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$	Cibo	-	2.5	pF
Current Gain — High Frequency 2N4260 (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz) 2N4261	h _{fe}	16 20		-

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	山水 華 一一一二	Symbol	Min	Max	Unit
Collector Base Time Constant		rb'C _C			ps
$(I_C = 5.0 \text{ mAdc}, V_{CE} = 4.0 \text{ Vdc}, f = 31.8 \text{ MHz})$	2N4260		1935	35	
	2N4261		1	60	
(I - 10 - Ad- V - 10 Vd- 6 21 0 MIL-)	2014260			20	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 31.8 \text{ MHz})$	2N4260 2N4261			30	
	2114261			50	75.
				erformance	
			(vout =	= 1.0 V)	

SWITCHING CHARACTERISTICS

SWITCHING CHARACTERISTICS		@ 10 mA	@ 30 mA	
Rise Time	t _r	0.5	0.9	cons
Fall Time 81 01 02 0.6 0.5 0.1 05	of tf	1.0	1.2	ns
Turn-On Time Pro Wisheld ROLLELION S	ton(delay)	1.0	1.2	ns
Turn-Off Delay Time	toff(delay)	1.0 38	1.2	ns



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

MAXIMUM RATINGS

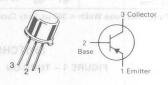
WAXIIVOW RATINGS							
Rating	Symbol	Value	Unit				
Collector-Emitter Voltage	VCEO	80	Vdc				
Collector-Base Voltage	VCBO	80	Vdc				
Emitter-Base Voltage	VEBO	5.0	Vdc				
Collector Current — Continuous	IC	1.0	Adc				
Total Device Dissipation @ $T_A = 25$ °C Derate above 25°C	PD	1.25 7.15	Watts mW/°C				
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D	8.75 50	Watts mW/°C				
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C				

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	25	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	140	°C/W

2N4405

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

ELECTRICAL	CHARACTE	RISTICS	$(T_A =$	25°C unless	otherwise	noted.)

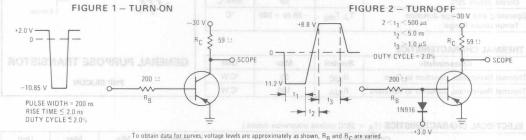
Characteristic	invests at a parent sortings at shoot,	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mA	dc, I _B = 0)	V(BR)CEO	80		Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc$, I_E	= 0)	V(BR)CBO	80	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C$	= 0)	V _{(BR)EBO}	5.0	a anubit	Vdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0)		Ісво		25	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)		IEBO	-	25	nAdc
ON CHARACTERISTICS			MILL		I I I I
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 5.0 Vdc)	2N4404 2N4405	hFE	30 75	=	1 - Too
(I _C = 10 mAdc, V_{CE} = 5.0 Vdc)	2N4404 2N4405		40 100		
$(I_C = 150 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})(1)$	2N4404 2N4405		40 100	120 300	
$(I_C = 500 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})(1)$	2N4404 2N4405	98 08 08 01 0	30 50	or a <u>n</u> Eu	io ro
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) = 3440117 (I _C = 150 mAdc, I _B = 15 mAdc)(1) (I _C = 500 mAdc, I _B = 50 mAdc)(1)	y1001 and	VCE(sat)	6 - 5 ELA	0.15 0.2 0.5	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 1.0 mAdc) (IC = 500 mAdc, I _B = 50 mAdc)(1)	90	V _{BE} (sat)	— 0.85	0.8 1.2	Vdc
Base-Emitter On Voltage (I _C = 150 mAdc, V _{CE} = 1.0 Vdc)	HE =	VBE(on)		0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS			-15/1-		
Current-Gain — Bandwidth Product ($I_C = 50$ mAdc, $V_{CE} = 20$ Vdc, $f = 100$ MHz)	W = U	fT	200	600	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	01	C _{cb}	M	10	pF
Emitter-Base Capacitance		C _{eb}		75	pF

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}C$ unless otherwise noted.)

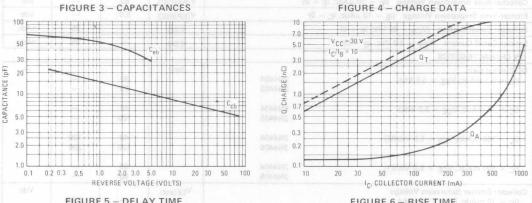
Characteristic		Symbol	Min	Max	Unit	
SWITCHING CHARACTE	RISTICS				RATINGS N	HUMBKAM
Delay Time	$I_{C} = 30 \text{ Vdc}, V_{BE(off)} = 2.0 \text{ Vdc},$ $I_{C} = 500 \text{ mAdc}, I_{B1} = 50 \text{ mAdc})$	Variage	t _d	_	201115	ns
Rise Time (gAzes-(O to tr		25	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAdc)	98	OHOV ts		175	ns
Fall Time			OBBV tf		35	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS



TRANSIENT CHARACTERISTICS





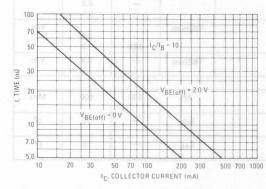
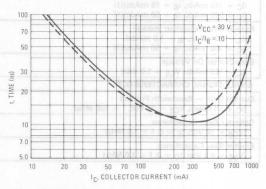
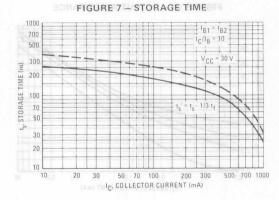
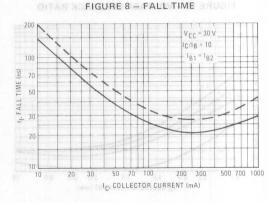


FIGURE 6 - RISE TIME





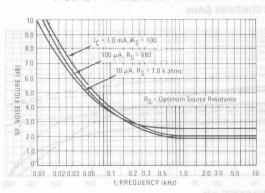


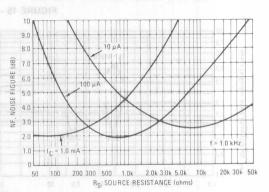
SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE $V_{CE} = 10 \text{ Vdc}, T_A = 25 ^{\circ}\text{C}$

FIGURE 9 - FREQUENCY EFFECTS

FIGURE 10 - SOURCE RESISTANCE EFFECTS



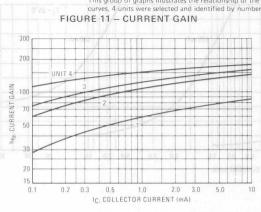


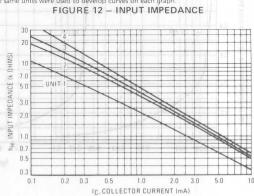
h PARAMETERS $V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}, T_A = 25 ^{\circ}\text{C}$

This group of graphs illustrates the relationship of the "h" parameters for this series of transistors. To obtain these curves, 4 units were selected and identified by number – the same units were used to develop curves on each graph.

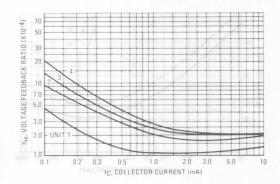
RE 11 – CURRENT GAIN

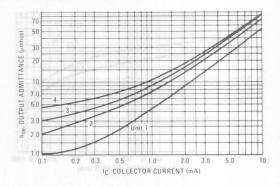
FIGURE 12 – INPUT IMPEDANCE





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





STATIC CHARACTERISTICS

FIGURE 15 - DC CURRENT GAIN

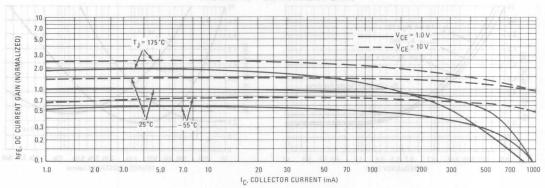
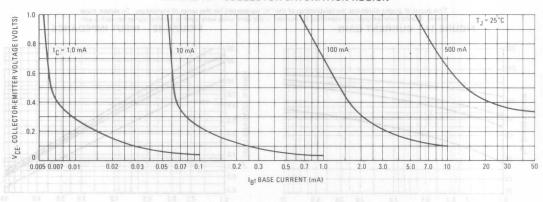
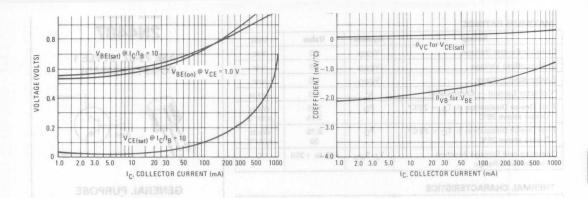


FIGURE 16 - COLLECTOR SATURATION REGION

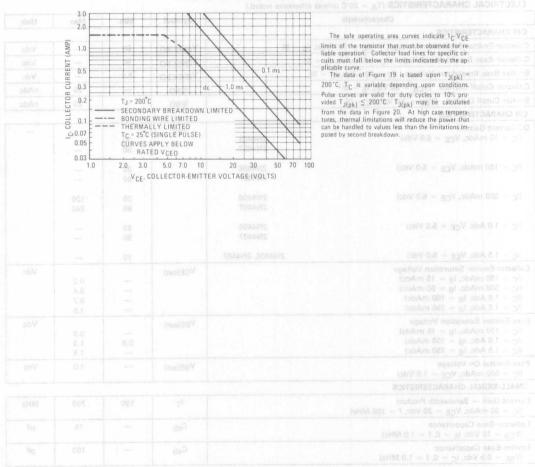






RATINGS AND THERMAL DATA

FIGURE 19 - SAFE OPERATING AREA



MAYIMLIM BATINGS

MAXIMUM RATINGS			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	80	Vdc
Collector-Base Voltage	VCBO	0.1-80	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	2.0	Amps
Total Device Dissipation @ T _A = 25°C* Derate above 25°C	PD	1.25 7.15	Watts mW/°C
Total Device Dissipation $(a T_C = 25^{\circ}C^*)$ Derate above 25°C	PD	8.75 50	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	800 TUBB

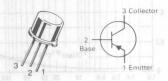
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	20	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	140	°C/W

2N4406 2N4407

2044404 2044408

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

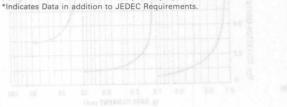
ELECTRICAL	CHARACTERISTICS	$(T_{\Delta} =$	25°C unless	otherwise r	noted.)
------------	-----------------	-----------------	-------------	-------------	---------

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		1			
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B	= 0)	V(BR)CEO	80	E 04 8	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V(BR)CBO	80	111 – 2	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	5.0	1 AM 10	Vdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0)	HITT X X most	Ісво		25	nAdd
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	11/4/11/	IEBO	0 005 415	25	nAdd
ON CHARACTERISTICS AND TAX OF CHARACTERISTICS	XX X warm	WIRE LIMITED	SONGING -	value 1 m E	
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	2N4406 2N4407	hFE 1941	30 80	100,0 L2 2000	-
(I _C = 150 mAdc, V _{CE} = 5.0 Vdc)	2N4406 2N4407	OF DY DE	30 80	0:1	
$(I_C = 500 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	2N4406 2N4407		30 80	120 240	
$(I_C = 1.0 \text{ Adc, } V_{CE} = 5.0 \text{ Vdc)}$	2N4406 2N4407		20 30	=	
$(I_C = 1.5 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc})$	2N4406, 2N4407		10	- I	
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc) (I _C = 1.5 Adc, I _B = 150 mAdc)		VCE(sat)	=	0.2 0.4 0.7 1.5	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc) (I _C = 1.5 Adc, I _B = 150 mAdc)		VBE(sat)	0.9	0.9 1.3 1.5	Vdc
Base-Emitter On Voltage (I _C = 500 mAdc, V _{CE} = 1.0 Vdc)		V _{BE(on)}	-	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				THE RESERVE	
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)		fT	150	750	MH
Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_{E} = 0$, $f = 1.0 \text{ MHz}$)		C _{cb}	<u> </u>	15	pF
Emitter-Base Capacitance $(V_{BF} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$		C _{eb}	-	160	pF

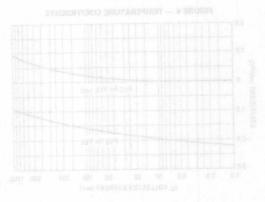
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

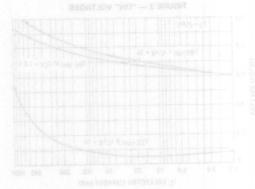
	Characteristic	Symbol	Min	Max	Unit
SWITCHING CHARA	ACTERISTICS	WIND TYPE	man year		
Delay Time	(V _{CC} = 30 Vdc, V _{BE(off)} = 2.0 Vdc,	td		15	ns
Rise Time	$I_C = 1.0 \text{ Adc}, I_{B1} = 100 \text{ mAdc})$	t _r		60	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 1.0 Adc,	t _s		175	ns
Fall Time	$I_{B1} = I_{B2} = 100 \text{ mAdc}$	tf		50	ns

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

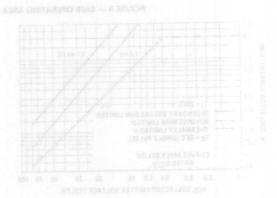


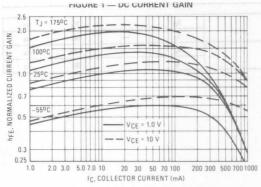


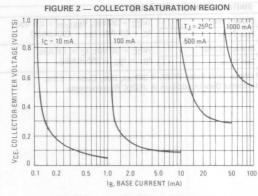


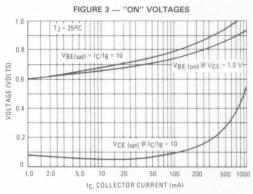


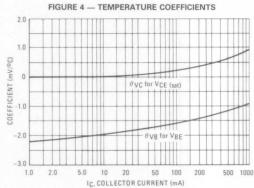


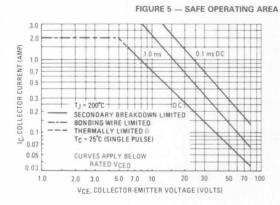












The safe operating area curves indicate I_C – V_{CE} limits of the transistor that must be observed for reliable operation. Collector load lines for specific circuits must fall below the limits indicated by the applicable curve.

The data of Figure 5 is based upon $T_{J(pk)}=200^{\circ}C$; T_{C} is variable depending upon conditions. Pulse curves are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200^{\circ}C$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

214453

TRANSIENT CHARACTERISTICS

____ 25°C ——— 100°C

FIGURE 7 - CAPACITANCES

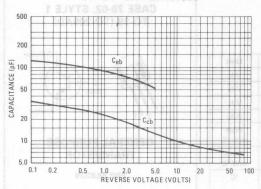


FIGURE 8 - CHARGE DATA

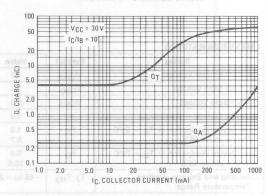


FIGURE 9 - TURN-ON TIME

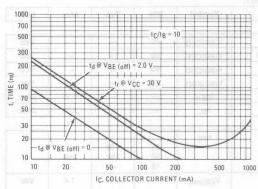
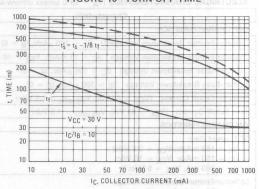


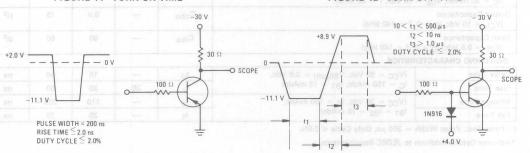
FIGURE 10 - TURN-OFF TIME



SWITCHING TIME EQUIVALENT TEST CIRCUITS

FIGURE 11 - TURN-ON TIME

FIGURE 12 - TURN-OFF TIME



2N4890

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N4033 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	Vсво	60	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.7	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					OW
Collector-Emitter Breakdown Voltage(1) (I _C = 100 μAdc, I _B = 0)		40			Vdc
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, R _{BE} = 10 ohms)	V(BR)CER	50			Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	V(BR)CBO	60	(fig) 38 V W		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	V(BR)EBO	5.0	10-1		Vdc
Collector Cutoff Current (VCE = 60 Vdc, VBE(off) = 1.5 Vdc)	ICEX	- 11		0.25	μAdo
Base Cutoff Current (VCE = 60 Vdc, VBE(off) = 1.5 Vdc)	IBL	1	1	0.25	μAdo
ON CHARACTERISTICS				187	30
DC Current Gain (IC = 150 mAdc, V_{CE} = 2.5 Vdc) (IC = 150 mAdc, V_{CE} = 10 Vdc) *(IC = 500 mA, V_{CE} = 5 Vdc(1)	hFE	25 50 15	130 140	250 —	01 nt = 0.0
Collector-Emitter Saturation Voltage 103 at (I _C = 150 mAdc, I _B = 15 mAdc)		TW39(dU) HO	0.12	1.4	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)		-	0.82	1.7	Vdc
Base-Emitter On Voltage (IC = 150 mAdc, VCE = 2.5 Vdc)	V _{BE(on)}	-	0.74	1.7	Vdc
SMALL-SIGNAL CHARACTERISTICS	DART DO	DESTRUCT			
Current-Gain — Bandwidth Product ($I_C = 50 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 20 \text{ MHz}$)	fT	100	280	UDIT	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 140 kHz)	Cobo	-	9.0	15	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 140 kHz)	Cibo	-	60	80	pF
SWITCHING CHARACTERISTICS	44.8		v 0		9.0.53
Delay Time (V _{CC} = 30 Vdc, V _{BE(off)} = 0.8 Vdc,	td	_	15	50	ns
Rise Time $I_C = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc})$	tr	20	20	50	ns
Storage Time (V _{CC} = 30 Vdc, I _C = 150 mAdc,	ts	_	110	200	ns
Fall Time IB1 = IB2 = 15 mAdc)	tf	_	20	70	ns

TRANSIENT CHARACTERISTICS

⁽¹⁾ Pulse Test: Pulse Width = 300 μ s, Duty Cycle \leq 2.0%.

^{*}Indicates Data in Addition to JEDEC Requirements.

MAXIMUM RATINGS

WAXIMOWITATIIEGO	1 - 1 -			
Rating	Symbol	2N4926	2N4927	Unit
Collector-Emitter Voltage	VCEO	200	250	Vdc
Collector-Base Voltage	VCBO	200	250	Vdc
Emitter-Base Voltage	VEBO	sav 7	.0	os Vdc
Collector Current — Continuous	Ic	osv 5	0	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	1.0 5.71		Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD		.0 3.6	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	+ 200	1.8 °C 1

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	175	°C/W

2N4926 2N4927

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

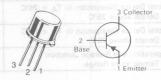
C	haracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	- SOME SE				antaine to	ASAHO TRO
Collector-Emitter Breakdown Voltage $(I_C = 10 \text{ mAdc}, I_B = 0)$	(1) 030(88)V	2N4926 2N4927	V(BR)CEO	200 250	Her Breakd Ado, Ig = 1	Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mAdc, I _C = 0)		2N4926 2N4927	V _(BR) CBO	200 250	wohle III a	Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	Gautaly.	2N/1928 2N/4929	V(BR)EBO	7.0	рАц, (101 —	Vdc
Collector Cutoff Current (VCB = 100 Vdc, I _E = 0)		2N4926	ІСВО		0.1	μAdc
(V _{CB} = 100 Vdc, I _E = 0, T _A = 100 (V _{CB} = 150 Vdc, I _E = 0) (V _{CB} = 150 Vdc, I _E = 0, T _A = 100		2N4927		Valta y e)) — ((10 0.1 10	007 = 50
Emitter Cutoff Current (VBE = 5.0 Vdc)			IEBO		Vdc.lg = 0.1bV	μAdc
ON CHARACTERISTICS (1)		2N4980, 2N4931		(0	9 V66, lg =	04c8 = 18
DC Current Gain	$(I_C = 10 \text{ mAc})$ $(I_C = 30 \text{ mAc})$	dc, V _{CE} = 10 Vdc) lc, V _{CE} = 10 Vdc) lc, V _{CE} = 10 Vdc) lc, V _{CE} = 20 Vdc)	hFE	10 15 20 20	200	18 = 38V) 18 = 38V) 18 = 38V) 18 = 30V
Collector-Emitter Saturation Voltage		dc, l _B = 1.0 mAdc) dc, l _B = 3.0 mAdc)	VCE(sat)	10. Ve lc)	100000000000000000000000000000000000000	Vdc
Base-Emitter Saturation Voltage		dc, lg = 1.0 mAdc) dc, lg = 3.0 mAdc)	V _{BE} (sat)	10 V <u>d</u> c)(1)	1.2	Vdc
Base-Emitter On Voltage (I _C = 30 n	nAdc, V _{CE} = 1	0 Vdc)	V _{BE(on)}		1.5	Vdc
SMALL-SIGNAL CHARACTERISTICS					= 30V JohA	m 08 = 3l)
Current-Gain — Bandwidth Product	$(I_C = 10 \text{ mAd})$	c, V _{CE} = 20 Vdc, f = 20 MHz)	fT	30	300	MHz
Collector-Base Capacitance (V _{CB} =	20 Vdc, IE = 0), f = 140 kHz)	C _{cb}	legs/row no	6.0	pF
Input Impedance (I _C = 10 mAdc, V	CE = 10 Vdc, f	= 1.0 kHz)	hie	75	2000	ohm
Voltage Feedback Ratio (I _C = 10 m.	Adc, V _{CE} = 10	Vdc, f = 1.0 kHz)	h _{re}	0.1	2.0	X 10-4
Small-Signal Current Gain (I _C = 10	mAdc, V _{CE} =	10 Vdc, f = 1.0 kHz)	hfe	25	250	u 01 = 01)
Output Admittance (I _C = 10 mAdc,	V _{CE} = 10 Vdc	, f = 1.0 kHz)	hoe	_	50	μmhos
Real Part of Input Impedance (IC =	10 mAdc, VCE	= 20 Vdc, f = 5.0 MHz)	Re(hie)	4.0	200	ohms

MAXIMUM RATINGS

Rating	Symbol	2N4928	2N4929	2N4930	2N4931	Unit
Collector-Emitter Voltage	VCEO	100	150	200	250	Vdc
Collector-Base Voltage	VCBO	100	150	200	250	Vdc
Emitter-Base Voltage	VEBO	4.0	4.0	4.0	4.0	Vdc
Collector Current — Continuous	lc	100	500	500	500	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.6 3.4	1.0 5.71	1.0 5.71	1.0 5.71	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	3.0 17.2	5.0 28.6	5.0 28.6	5.0 28.6	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}			+200	35	°C

ZN4351

2N4930 and 2N4931 JAN, JTX & JTXV AVAILABLE CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE
TRANSISTOR

PNP SILICON

Refer to 2N3494 for graphs for 2N4928.*

ELECTRICAL	CHARACTERISTICS	$(T_{\Delta} =$	25°C unless	otherwise	noted.)
------------	-----------------	-----------------	-------------	-----------	---------

Intil XaM HIM CI	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						2
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	1)033(89)	2N4928 2N4929	V _(BR) CEO	100 150	= gl.,5bAm	Vdc
		2N4930 2N4931		200 250	vobils <u>e</u> 18 sei = jl_obAm	
Collector-Base Breakdown Voltage (IE = 0, IC = 100 μ Adc)	OBBIRBIV	2N4928 2N4929	V(BR)CBO	100 150	e Bra <u>ak</u> down mAd <u>a_</u> Ig = I	
		2N4930 2N4931		200 250	toff Serenting	CV _{CS} = 1
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)		SINABSZ	V(BR)EBO	4.0	00 Vdc, lg = 50 Vdc, lg =	Vdc
Collector Cutoff Current $(V_{CB} = 50 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 75 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 150 \text{ Vdc}, I_E = 0)$	OB3)	2N4928 2N4929 2N4930, 2N4931	Ісво		0.5 0.5 1.0	μAdc - agV
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0) (VBE = 3.0 Vdc, I _C = 0)		2N4928, 2N4929 2N4930, 2N4931	10c = 10 mAde.	=	0.5 1.0	μAdc
ON CHARACTERISTICS						
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc)		All Types	abAm hFE off	20	_	13 tof <u>oe</u> llo
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$		2N4928, 2N4929 2N4930, 2N4931	ilig = 10 mAde. Ug = 50 mAde.	25	200	ase-Em tte
		2144330, 2144331	Ada, Vas = 10 /	20	200	
$(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$ $(I_C = 30 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$		2N4928, 2N4929 2N4930, 2N4931	and of a sile	20 20	IARAFED JAVI Diwoned —	
Collector-Emitter Saturation Voltage((I _C = 10 mAdc, I _B = 1.0 mAdc)	1) do	2N4928, 2N4929 2N4930, 2N4931	VCE(sat)	26 (V _{GB} = 10 m <u>A</u> de, V _G	0.5 5.0	a roVdclo
Base-Emitter On Voltage (IC = 10 mAdc, VCF = 10 Vdc)	DALL.	3c, f = 1.0 kHz)	V _{BE(on)}	01_= 30 mA	1.0	Vdc

Characteristic				Symbol	Min	IViax	Unit
SMALL-SIGNAL CHARACTERISTICS	- V	700		8307	-	Digital to the	1
Current-Gain — Bandwidth Product (IC = 20 mAdc, VCE = 20 Vdc, f = 100 MHz) (IC = 20 mAdc, VCE = 20 Vdc, f = 20 MHz)	V		2N4929 2N4931	OBD fT	100	1,000	MHz
Collector-Base Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 140 kHz) (V _{CB} = 20 Vdc, I _E = 0, f = 140 kHz) (V _{CB} = 20 Vdc, I _E = 0, f = 140 kHz)	Watts	2N4928 2N4929 2N4930,	2N4931	C _{cb}	PER TAT	6.0 10 20	Page Veri ctal Davide Devate and
Emitter-Base Capacitance (VBE = 2.0 Vdc, I _C = 0, f = 140 kHz) (VBE = 1.0 Vdc, I _C = 0, f = 140 kHz) (VBE = 0.5 Vdc, I _C = 0, f = 140 kHz)	3°W:	2N4928 2N4929	2N4931	C _{eb}	notion	40 80 400	odo e pFza ne gnastaq uturuqme (

(1) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%. Refer to 2N3634 for graphs for 2N4929. Refer to 2N3743 for graphs for 2N4930 and 2N4931.

2N5022 2N5023		

MAXIMUM RATINGS

Rating	Symbol	2N5022	2N5023	Unit
Collector-Emitter Voltage	VCEO	50	30	V
Collector-Emitter Voltage	VCES	50	30	V
Collector-Base Voltage	VCBO	50	30	V
Emitter-Base Voltage	VEBO	8384	5	V
Collector Current — Continuous (Pulse Width = 300 μs, DC = 1%)	lc	1.0*		Α
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	P _D 1.0 5.72		Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D 4.0 22.8			Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg} -65 to +200		o +200	°C
Maximum Lead Temperature (Soldering, 60 sec max)	TL	+	300	°C

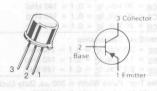
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	43.8	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	175	°C/W

*Indicates Data in Addition to JEDEC Requirements.

2N5022 2N5023

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N3467 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (IC = 100 μ Adc)	2N5022 2N5023	V(BR)CES	50 30	=	V
Collector-Emitter Sustaining Voltage (I _C = 10 mAdc)	2N5022 2N5023	V(BR)CEO(sus)*	50 30	=	٧
Collector-Base Breakdown Voltage (IC = 100 μ Adc)	2N5022 2N5023	V(BR)CBO	50 30	=	٧
Emitter-Base Breakdown Voltage (IE = 100 μ Adc)	All	V(BR)EBO	5.0	-	V
Collector Cutoff Current (VCE = 30 Vdc) (VCE = 20 Vdc) (TA = 100°Cdc)	2N5022 2N5023	ICES	=	100 15	nA μA
ON CHARACTERISTICS					
DC Current Gain(1) (IC = 100 mA, V_{CE} = 1.0 Vdc)	2N5022 2N5023	hFE	15 30	=	_
$(I_C = 500 \text{ mA}, V_{CE} = 1.0 \text{ Vdc})$	2N5022 2N5023		25 40	100 100	
$(I_C = 1.0 \text{ A, V}_{CE} = 5.0 \text{ Vdc})$	2N5022 2N5023		25 40	=	
$(I_C = 500 \text{ ma}, V_{CE} = 1.0 \text{ V}, T_A = -55^{\circ}\text{C})$	2N5022 2N5023		10 20		
Collector-Emitter Saturation Voltage(1) (I _C = 100 mAdc, I _B = 10 mAdc)	2N5022 2N5023	VCE(sat)		0.20 0.17	V
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$	2N5022 2N5023		=	0.40 0.35	v
$(I_C = 1.0 \text{ Adc}, I_B = 100 \text{ mAdc})$	2N5022 2N5023		=	0.80 0.70	v

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic				Symbol	Min	Max	Unit
Base-Emitter Saturation Voltage				VBE(sat)		BATINGS	STEENEY AND
(I _C = 100 mAdc, I _B = 10 mAdc)			BEGRANS	Symbol	_	1.0	V
(I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)			300		0.8	1.4 1.75	nd-roV
SMALL-SIGNAL CHARACTERISTICS	oby	280	300	GBOY		Shippe 4 as	MECHANISM HOL
Collector-Base Capacitance	SBV	0.8	0.0	Ccb		25	pF
$(V_{BE} = 0.5 \text{ V, f} = 100 \text{ kHz})$	obiAm		19	0	auoun	med — men	už rotoriloš
Emitter-Base Capacitance (V _{BE} = 0.5 V, f = 100 kHz)	tioW 275Vm		1. f 12. d	C _{eb}	0 TA 25°C	100	ds stand
Small-Signal Current Gain (I _C = 50 mA, V _{CE} = 10 V, f = 100 MHz)	2N50		53.	hfe	1.7	Dissipation Ve 25t0	do stand
- 11/2	2N50	023	on 28 -	Last I	2.0	d Storage J	perating at
SWITCHING CHARACTERISTICS						re Range	Temperatu
Turn-On Time (V _{CE} = -30 V, I _C ≈ 500 mA, I _B ≈ 50 mA)				^t on	RISTICS	40 CHARACTI	ns IAMRBHT
Turn-Off Time	Unit		Nis	toff	— pilic	90	ns
$(V_{CE} = 30 \text{ V}, I_{C} \approx 500 \text{ mA}, I_{B1} = I_{B2} \approx 50 \text{ mA})$	165-39		ie l	Bywell I	dion to Case	and something	uell Ismred
1) Pulse Width = 300 μ s, Duty Cycle = 1.0%.							

ZNE058		
36 mAdc, 1g = 3.0 mAdd)		

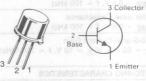
MAXIMU	M RATINGS					
V	Rating		Symbol	2N5058	2N5059	Unit
Collector-E	mitter Voltage		VCEO	300	250	Vdc
Collector-B	ase Voltage		VCBO	300	250	Vdc
Emitter-Bas	se Voltage		VEBO	7.0	6.0	Vdc
Collector C	urrent — Contin	uous	IC	1	50	mAdc
	e Dissipation @ pove 25°C	$T_A = 25^{\circ}C$	de PD		.0 67	Watt mW/°C
	e Dissipation (a bove 25°C	$T_C = 25^{\circ}C$	PD		3.3	Watts mW/°C
and the second second second	and Storage Jur ture Range	nction	TJ, T _{stg}	- 65 to	+ 200	°C

THERMAL CHARACTERISTICS

Characteristic —	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	30	°C/W
Thermal Resistance, Junction to Ambient	R _θ JA (1)	150	°C/W

2N5058 ADMITTALE 2N5059

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3724 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (2) $(I_C = 30 \text{ mAdc}, I_B = 0)$	2N5058 2N5059	V(BR)CEO	300 250	<u> </u>	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	2N5058 2N5059	V(BR)CBO	300 250		Vdc
Emitter-Base Breakdown Voltage $(I_E = 100 \mu Adc, I_C = 0)$	2N5058 2N5059	V(BR)EBO	7.0 6.0		Vdc
Collector Cutoff Current $(V_{CB} = 100 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 100 \text{ Vdc}, I_E = 0, T_A = 0)$	+ 125°C)	ІСВО	_	0.05 20	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)		IEBO	_	10	nAdc
ON CHARACTERISTICS (2)					
DC Current Gain ($I_C = 5.0 \text{ mAdc}$, $V_{CE} = 25 \text{ Vdc}$)	2N5058 2N5059	hFE	10 10	_	_
$(I_C = 30 \text{ mAdc}, V_{CE} = 25 \text{ Vdc})$	2N5058 2N5059		35 30	150 150	7
(I _C = 30 mAdc, V_{CE} = 25 Vdc, T_{A} = -55° C)	2N5058		10	-	
$(I_C = 100 \text{ mAdc}, V_{CE} = 25 \text{ Vdc})$	2N5058 2N5059		35 30		
Collector-Emitter Saturation Voltage $(I_C = 30 \text{ mAdc}, I_B)$	= 3.0 mAdc)	V _{CE(sat)}		1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 30 mAdc, I _B = 3	.0 mAdc)	V _{BE(sat)}		0.85	Vdc
Base-Emitter On Voltage ($I_C = 30 \text{ mAdc}$, $V_{CE} = 25 \text{ Vdc}$:)	V _{BE} (on)	_	0.82	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (3) (I _C = 10 mAdc,	V _{CE} = 25 Vdc, f = 20 MHz)	fT	30	160	MHz
Collector-Base Capacitance $(V_{CB} = 10 \text{ Vdc}, I_{E} = 0, f =$	1.0 MHz)	C _{cb}	-	10	pF
Emitter-Base Capacitance ($V_{BE} = 0.5 \text{ Vdc}$, $I_{C} = 0$, $f = 1$	1.0 MHz)	Ceb	_	75	pF

⁽¹⁾ $R\theta_{JA}$ is measured with the device soldered into a typical printed circuit board.

⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽³⁾ f_T is defined as the frequency at which the $|h_{fe}|$ extrapolates to unity.

MAXIMUM RATINGS

MAXIMUM RATINGS			
Rating	Symbol	Value	Unit
Emitter-Collector Voltage	VECO	20	Vdc
Collector-Base Voltage	VCBO	30	Vdc
Emitter-Base Voltage	VEBO	30	Vdc
Collector Current — Continuous	IC	50	mAdc
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	0.5 2.86	Watt mW/°C
Total Device Dissipation (α T _C = 25°C Derate above 25°C	PD	2.0	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

CASE 26-03, STYLE 1 TO-46 (TO-206AB)



LOW POWER CHOPPER TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	CURRENT	Various BASI		
Emitter-Collector Breakdown Voltage (I _E = 10 μAdc, I _B = 0)	V(BR)ECO	20		Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	30	362	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	30		Vdc
Collector Cutoff Current (V _{CB} = 25 Vdc, I _E = 0)	СВО	- 1	1.0	nAdc
Emitter Cutoff Current (VEB = 25 Vdc, IC = 0)	IEBO		1.0	nAdc
ON CHARACTERISTICS				11.8
DC Current Gain (IC = 100 µAdc, VCE = 1.0 Vdc) (IC = 200 µAdc, VCE = 0.5 Vdc) (Inverted Connection)	3 3085 hFE	50 15		20
Offset Voltage $(I_B = 100 \ \mu Adc, I_E = 0)$ $(I_B = 1.0 \ mAdc, I_E = 0)$	VEC(ofs)	Ig. BASE OU	0.5 1.0	mVdc
SMALL-SIGNAL CHARACTERISTICS US = 8 3 AUGI3	SUREV MIAD THER	RES - CURI	UDA	
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 140 kHz)	C _{cb}	2 MULT	5.0	pF
Emitter-Base Capacitance (VEB = 10 Vdc, I _C = 0, f = 140 kHz)	C _{eb}		4.0	pF
Small-Signal Current Gain (IC = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 4.0 MHz)	hfe	2.0	DRAC	
"ON" Series Resistance (I _B = 1.0 mAdc, I _F = 0, I _B = 100 μA RMS, f = 1.0 kHz)	rec(on)	2.0	8.0	Ohms

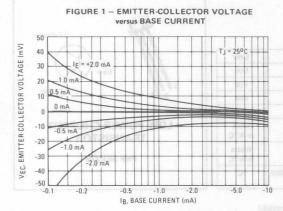


FIGURE 2 - EMITTER-COLLECTOR VOLTAGE versus JUNCTION TEMPERATURE

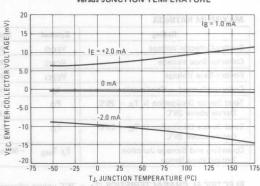
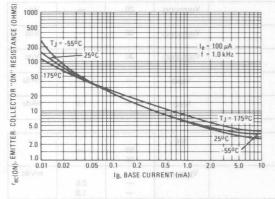
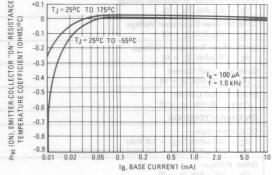
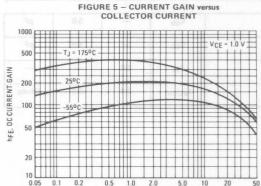


FIGURE 3 - EMITTER-COLLECTOR "ON" RESISTANCE versus BASE CURRENT

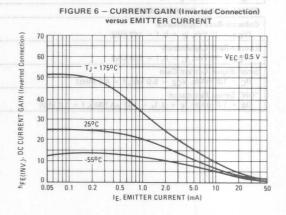








IC, COLLECTOR CURRENT (mA)





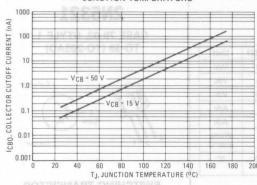


FIGURE 8 - EMITTER CUTOFF CURRENT versus JUNCTION TEMPERATURE

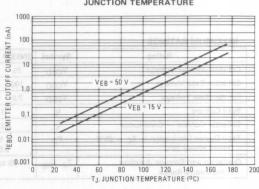


FIGURE 9 - COLLECTOR-EMITTER SATURATION VOLTAGE versus COLLECTOR CURRENT

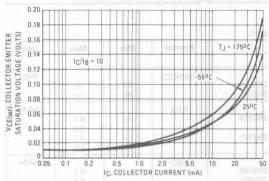
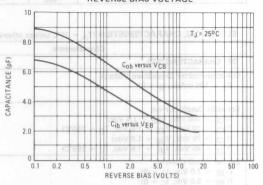


FIGURE 10 - JUNCTION CAPACITANCE versus REVERSE BIAS VOLTAGE





MAXIMUM RATINGS

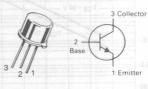
Rating	Symbol	2N5320	2N5321	Unit
Collector-Emitter Voltage	VCEO	75	50	Vdc
Collector-Base Voltage	VCBO	100	75	Vdc
Emitter-Base Voltage	VEBO	7.0	5.0	Vdc
Base Current	IB	Fro 91	.0	Adc
Collector Current — Continuous	lc	2.0		Adc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	13	0	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 65 to	+ 200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R_{θ} JC	17.5	°C/W

2N5320

CASE 79-02, STYLE 1 TO-39 (TO-205AD)

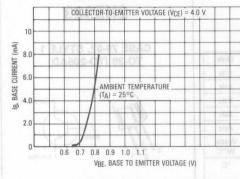


SWITCHING TRANSISTOR

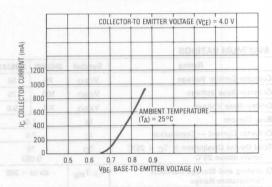
NPN SILICON

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	M			01 = 51(31	1 2
Collector-Emitter Breakdown Voltage (IC = 100 mAdc, IB = 0)	2N5320 2N5321	V(BR)CEO	75 50		Vdc
Collector Cutoff Current (VCE = 100 Vdc, VBE = 1.5 Vdc) (VCE = 70 Vdc, VBE = 1.5 Vdc, T _C = 150°C) (VCE = 75 Vdc, VBE = 1.5 Vdc) (VCE = 45 Vdc, VBE = 1.5 Vdc, T _C = 150°C)	2N5320 2N5321	ICEX		0.1 5.0 0.1 5.0	mAdc
Emitter Cutoff Current (VBE = 7.0 Vdc, I _C = 0) (VBE = 5.0 Vdc, I _C = 0)	2N5320 2N5321	O DEBO 0.5	0.5 1.0 10. COLETCION	0.1 0.1	mAdc
ON CHARACTERISTICS(1)					
DC Current Gain (IC = 500 mAdc, VCE = 4.0 Vdc)	2N5320 2N5321	hFE	30 40	130 250	_
$(I_C = 1.0 \text{ Adc}, V_{CE} = 2.0 \text{ Vdc})$	2N5320		10	-	
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)	2N5320 2N5321	VCE(sat)	=	0.5 0.8	Vdc
Base-Emitter On Voltage (I _C = 500 mAdc, V _{CE} = 4.0 Vdc)	2N5320 2N5321	VBE(on)	_	1.1 1.4	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Small-Signal Current Gain ($I_C = 50 \text{ mAdc}$, $V_{CE} = 4.0 \text{ Vdc}$, $f = 10 \text{ MHz}$)		h _{fe}	5	-	_
SWITCHING CHARACTERISTICS					
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 500 \text{ mAdc}, I_{B1} = 50 \text{ mAdc})$		ton	_	80	ns
Turn-Off Time (V _{CC} = 30 Vdc, I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAdc)		toff	-	800	ns

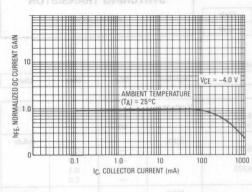




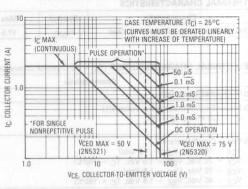
TYPICAL TRANSFER CHARACTERISTICS



CURRENT GAIN CHARACTERISTICS versus COLLECTOR-EMITTER VOLTAGE



MAXIMUM SAFE OPERATING AREAS (SOA)





ALL-SIGNAL CHARACTERISTICS

n Time - 30 Vdc, Ig - 500 mAdc, Ig1 = 50 mAdo) 11 Time

2N5322 2N5323

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





SWITCHING TRANSISTOR

PNP SILICON

MAXIMUM RATINGS

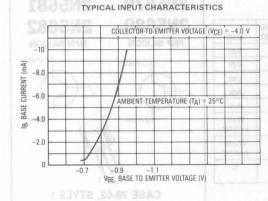
Rating	Symbol	2N5322	2N5323	Unit
Collector-Emitter Voltage	VCEO	75	50	Vdc
Collector-Base Voltage	VCBO	100	75	Vdc
Emitter-Base Voltage	VEBO	7.0	5.0	Vdc
Base Current	IB	1	.0	Adc
Collector Current — Continuous	Ic	2.0		Adc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	10 0.057		Watts W/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	-65 to +200	

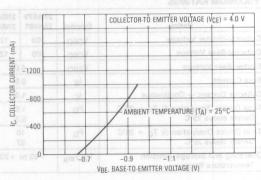
THERMAL CHARACTERISTICS

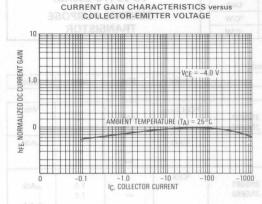
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _θ JC	17.5	°C/W

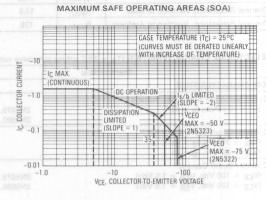
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	9	BUTARDSWET	veiena IIII L		
Collector-Emitter Breakdown Voltage(1) (I _C = 100 mAdc, I _B = 0)	2N5322 2N5323	V(BR)CEO	75 50		Vdc
Collector Cutoff Current (V _{CE} = 100 Vdc, V _{BE} = 1.5 Vdc) (V _{CE} = 70 Vdc, V _{BE} = 1.5 Vdc, T _C = 150°C) (V _{CE} = 75 Vdc, V _{BE} = 1.5 Vdc) (V _{CE} = 45 Vdc, V _{BE} = 1.5 Vdc, T _C = 150°C)	2N5322 2N5323	ICEX 011 (Am) TM38	÷1 ÷1 up Ao ro suno	0.1 5.0 0.1 5.0	mAdc
Emitter Cutoff Current $(V_{BE} = 7.0 \text{ Vdc}, I_{C} = 0)$ $(V_{BE} = 5.0 \text{ Vdc}, I_{C} = 0)$	2N5322 2N5323	IEBO	=	0.1 0.1	mAdo
ON CHARACTERISTICS(1)					
DC Current Gain ($I_C = 500 \text{ mAdc}$, $V_{CE} = 4.0 \text{ Vdc}$)	2N5322 2N5323	hFE	30 40	130 250	_
(I _C = 1.0 Adc, V _{CE} = 2.0 Vdc)	2N5322		10	_	
Collector-Emitter Saturation Voltage (IC = 500 mAdc, IB = 50 mAdc)	2N5322 2N5323	VCE(sat)		0.7 1.2	Vdc
Base-Emitter On Voltage ($I_C = 500 \text{ mAdc}$, $V_{CE} = 4.0 \text{ Vdc}$)	2N5322 2N5323	VBE(on)	_	1.1 1.4	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Small-Signal Current Gain (IC = 50 mAdc, V_{CE} = 4.0 Vdc, f = 10 MHz)		hfe	5	Ŧ	-
SWITCHING CHARACTERISTICS					
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, I_C = 500 \text{ mAdc}, I_{B1} = 50 \text{ mAdc})$		t _{on}	_	100	ns
Turn-Off Time $(V_{CC} = 30 \text{ Vdc}, I_C = 500 \text{ mAdc}, I_{B1} = I_{B2} = 50 \text{ mAdc})$		toff	-	1000	ns









Rating	Symbol	2N5679 2N5681	2N5680 2N5682	Unit
Collector-Emitter Voltage	VCEO	100	120	Vdc
Collector-Base Voltage	VCBO	100	120	Vdc
Emitter-Base Voltage	VEBO	008/4	.0	Vdc
Base Current	IB	0	0.5	
Collector Current — Continuous	Ic	1.0		Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.7		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		10 57	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 t	o +200	°C

PNP SILICON 3 Collector 2 Base 1 Emitter 1 Emitter

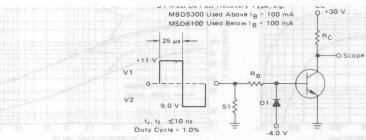
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	17.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	175	°C/W

CASE 79-02, STYLE 1 TO-39 (TO-205AD) GENERAL PURPOSE TRANSISTOR

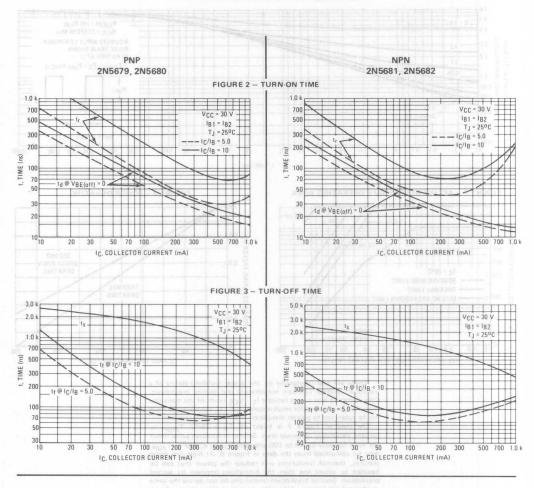
ELECTRICAL	CHARACTERISTICS	(TA	=	25°C	unless	otherwise	noted.)
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Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					Ha a
Collector-Emitter Sustaining Voltage (IC = 10 mAdc, IB = 0) 2N5679, 2N5681 2N5680, 2N5682		VCEO(sus)	100 120		Vdc
Collector Cutoff Current (VCE = 70 Vdc, I _B = 0) (VCE = 80 Vdc, I _B = 0)		ICEO	=	10 10	μAdc
Collector Cutoff Current (VCE = 100 Vdc, VEB = 1.5 Vdc) (VCE = 120 Vdc, VEB = 1.5 Vdc) (VCE = 100 Vdc, VEB = 1.5 Vdc, TC = 150°C) (VCE = 120 Vdc, VEB = 1.5 Vdc, TC = 150°C)	2N5679, 2N5681 2N5680, 2N5682 2N5679, 2N5681 2N5680, 2N5682	ICEX	a.t- a.t- i noto mi so gi	1.0 1.0 1.0	μAdc mAdc
Collector Cutoff Current $(V_{CB} = 100 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 120 \text{ Vdc}, I_{E} = 0)$	2N5679, 2N5681 2N5680, 2N5682	СВО	=	1.0 1.0	μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)		IEBO	_	1.0	μAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 250 mAdc, V _{CE} = 2.0 Vdc) (I _C = 1.0 Adc, V _{CE} = 2.0 Vdc)		hFE	40 5.0	150	_
Collector-Emitter Saturation Voltage (I _C = 250 mAdc, I _B = 25 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 200 mAdc)		VCE(sat)	Ξ	0.6 1.0 2.0	Vdc
Base-Emitter Saturation Voltage (I _C = 250 mAdc, V _{CE} = 2.0 Vdc)		V _{BE(sat)}	-	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product ($I_C = 100 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 10 \text{ MHz}$)		fT	30		_
Output Capacitance ($V_{CB} = 20 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$)		C _{obo}	-	50	pF
Small-Signal Current Gain (I _C = 0.2 Adc, V_{CE} = 1.5 Vdc, f = 1.0 kHz)		h _{fe}	40	-	_



RB and RC Varied to Obtain Desired Current Levels

For t_d and t_r , D1 is disconnected and V2 = 0 For PNP test circuit, reverse diode and voltage polarities.



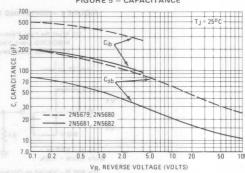


FIGURE 6 - THERMAL RESISTANCE

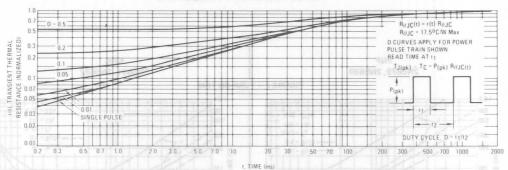


FIGURE 7 - ACTIVE-REGION SAFE OPERATING AREA

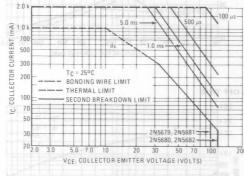
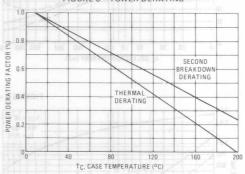
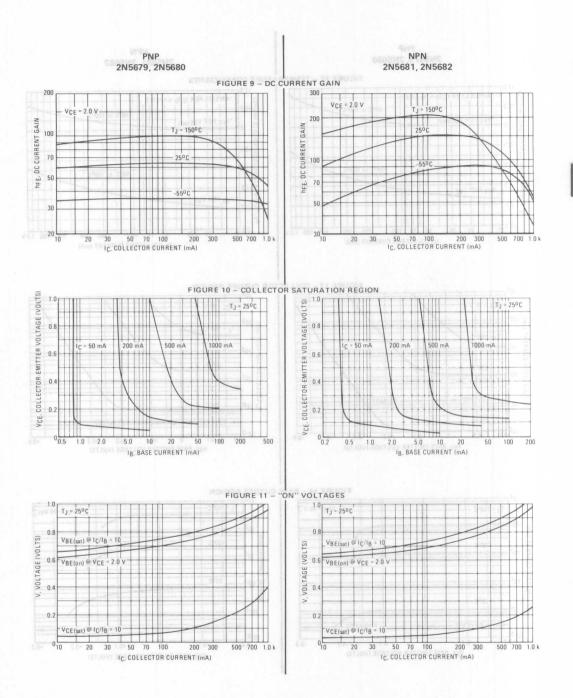


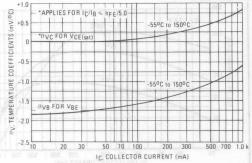
FIGURE 8 - POWER DERATING

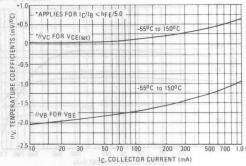


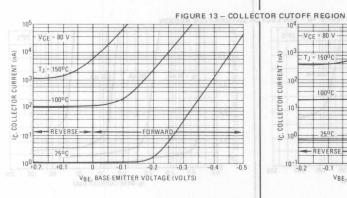
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. She operating area curves indicate I C · V CE limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

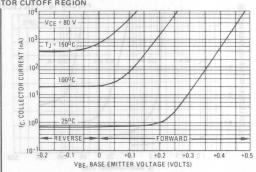
The data of Figure 7 is based on $T_C=25^{\circ}C$; $T_J(pk)$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_J(pk) \leqslant 200^{\circ}C$; $T_J(pk)$ may be calculated from the data in Figure 6. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 7 may be found at any case temperature by using the appropriate curve on Figure 8.

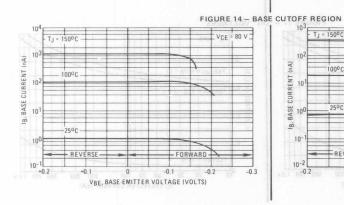


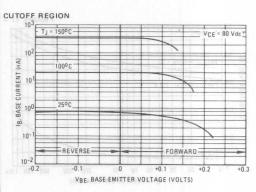












Hating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	80	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	IC	2.0	Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	1.0 6.0	Watt mW/°C
Total Device Dissipation (α T _C = 25°C Derate above 25°C	PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

3 Collector 2 Base 1 Emitter

CASE 79-02, STYLE 1 TO-39 (TO-205AD)

SWITCHING TRANSISTOR

NPN SILICON

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	175	°C/W

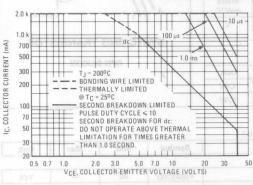
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	0.5	3.0 5.0	ES 01	18 9.0
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	31160 33V	Vdc
Collector-Base Breakdown Voltage (IC = 100 μAdc, IE = 0) ΤΟ ΔΗΔΗΟ ΟΠ ΙΑΟΙΚ	V(BR)CBO	80	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	6.0	minutes a	Vdc
Collector Cutoff Current (VCE = 50 Vdc, $V_{BE(off)}$ = 2.0 Vdc) (VCE = 50 Vdc, $V_{BE(off)}$ = 2.0 Vdc, T_A = 75°C)	ICEX		0.2 5.0	μAdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 75°C)	ІСВО		0.25 5.0	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO	1	0.1	μAdo
ON CHARACTERISTICS				
DC Current Gain (I _C = 500 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 Adc, V _{CE} = 1.0 Vdc) (I _C = 1.0 Adc, V _{CE} = 1.0 Vdc, T _A = -55°C)	hFE	30 15 10	120 100	03
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)			0.4 0.7	Vdc
Base-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)	V _{BE} (sat)	0.8	1.0 1.25	Vdc
SMALL-SIGNAL CHARACTERISTICS	005	50 160	- 20	11
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	MATERIA TANK	250	a1 —	MHz
Collector-Base Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kHz)	C _{cb}	ECTOR SA	7.0	pF
Emitter-Base Capacitance (VEB = 0.5 Vdc, IC = 0, f = 100 kHz)	C _{eb}		60	pF
SWITCHING CHARACTERISTICS				
Delay Time (V _{CC} = 30 Vdc, V _{BE(off)} = 2.0 Vdc, I _C = 1.0 Adc, I _{B1} = 100 mAdc) (Figures 8 and 10)	td		6.0	ns
Rise Time (V _{CC} = 30 Vdc, V _{BE(off)} = 2.0 Vdc, I _C = 1.0 Adc, I _{B1} = 100 mAdc) (Figures 8 and 10)	tr		30	ns
Storage Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 1.0 \text{ Adc}, I_{B1} = I_{B2} = 100 \text{ mAdc})$ (Figures 9 and 11)	t _S		35	ns
Sall Time (VCC = 30 Vdc, I _C = 1.0 Adc, I _{B1} = I _{B2} = 100 mAdc) (Figures 9 and 11)	tf		35	ns

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Max	Unit
Turn-On Time			ton		35	ns
$(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 2.0 \text{ Vdc}, I_{C} = 1.0 \text{ Adc}, I_{B1} = 100 \text{ mAdc}) \text{ (Figures 8 and 10)}$			DEDV		agatioV retir	-Bospalle
Turn-Off Time (V _{CC} = 30 Vdc, I _C = 1.0 Adc, I _{B1} = I _{B2} = 100 mAdc) (Figures 9 and 11)	ph.V	98	080 ^V toff		60	ns
			DBBV		Voltage	miner-Has

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

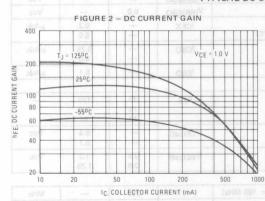
FIGURE 1 - ACTIVE-REGION SAFE OPERATING AREA

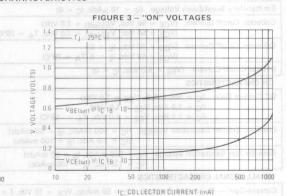


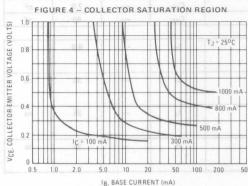
There are two limitations on the power handling ability of a transistor: junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

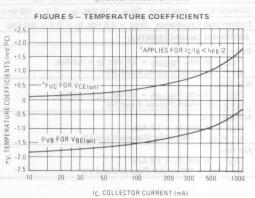
The data of Figure 1 is based on $T_{J(pk)} = 200^{\circ}C$; T_{C} is variable depending on conditions. Pulse curves are valid for duty cycles of 10% provided $T_{J(pk)} \leq 200^{\circ}C$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

DESCRIPTION TYPICAL DC CHARACTERISTICS OF A SILVERSION





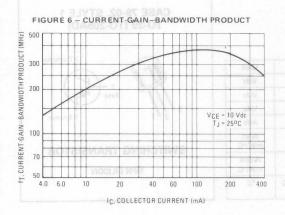


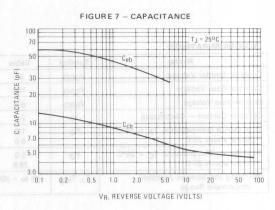


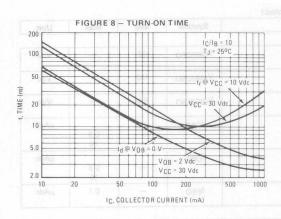
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

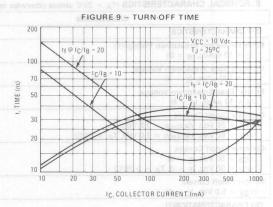
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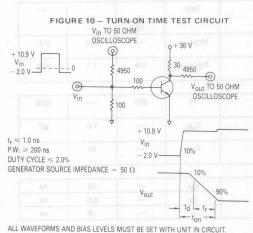
TYPICAL DYNAMIC CHARACTERISTICS

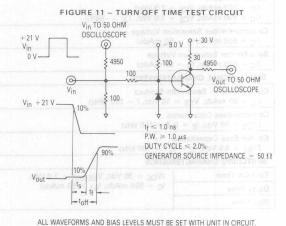










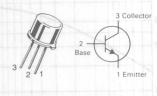


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	50	Vdc
Collector-Base Voltage	VCBO	100	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	2.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 6.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	004°C

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTIC	s IIII	T T Of safest			
Collector-Emitter Break (I _C = 10 mAdc, I _B =		V(BR)CEO	50		Vdc
Collector-Base Breakdo (I _C = 100 μAdc, I _E =		V(BR)CBO	100		Vdc
Emitter-Base Breakdov (I _E = 10 μAdc, I _C =		V(BR)EBO	6.0	1	Vdc
Collector Cutoff Currer (VCE = 50 Vdc, VBE (VCE = 50 Vdc, VBE		ICEX	31	0.3 10	μAdc
Collector Cutoff Currer (V _{CB} = 50 Vdc, I _E = (V _{CB} = 50 Vdc, I _E =	0)	СВО	0 v	0.3 10	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, I _C	= 0) (3 86738) (6) (6)	IEBO	OLFECTOR CO.	0.1	μAdc
ON CHARACTERISTIC	S(1)				
DC Current Gain (I _C = 500 mAdc, V _C (I _C = 500 mAdc, V _C	E = 1.0 Vdc) E = 1.0 Vdc, T _A = -55°C)	TEST CIRCUIT		100 3 9	upia —
Collector-Emitter Satur (I _C = 500 mAdc, I _B	ration Voltage = 50 mAdc)	V _{CE(sat)}	_39008	0.5	Vdc
Base-Emitter Saturation (IC = 500 mAdc, IB		V _{BE} (sat)	0.8	1.1	Vdc
SMALL-SIGNAL CHAP	RACTERISTICS	Void TO 50 OHM	7-12-	1-0	
Current-Gain — Bandy (I _C = 50 mAdc, V _{CE}	vidth Product = 10 Vdc, f = 100 MHz)	f _T	200	- 11	MHz
Collector-Base Capacit (V _{CB} = 10 Vdc, I _E =		C _{cb}	Vent+	7.0	pF
Emitter-Base Capacita (VBE = 0.5 Vdc, I _C		C _{eb}	-2.9 V	60	pF05
SWITCHING CHARAC	TERISTICS	1905	£1.0g	- SDMAGBSNCE	172012 MUTA
Turn-On Time	(V _{CC} = 30 Vdc, V _{BE(off)} = 2.0 Vdc,	ton	-	25	ns
Delay Time	$I_C = 500 \text{ mAdc}, I_{B1} = 50 \text{ mAdc})$	td	500*	8.0	ns
Rise Time	lar tip for	tr		18	ns

Storage Time	IRI - IRS - on HWard	VIETO ts (1) -	35	ns	
Fall Time		tf	_	35	ns	

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%

TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 1 - CURRENT-GAIN-BANDWIDTH PRODUCT

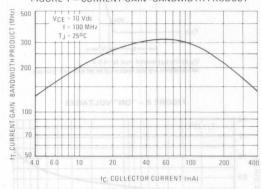


FIGURE 2 - CAPACITANCE

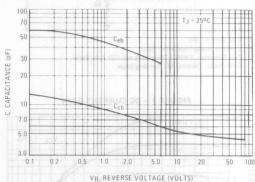


FIGURE 3 - TURN-ON TIME

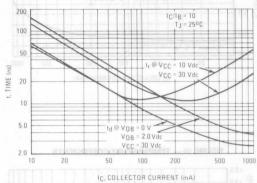


FIGURE 4 - TURN-OFF TIME

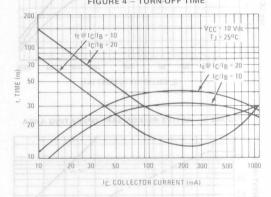
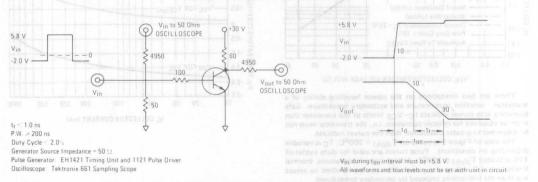
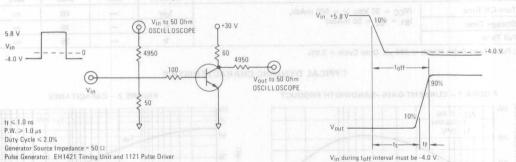


FIGURE 5 - TURN-ON TIME TEST CIRCUIT







Oscilloscope: Tektronix 661 Sampling Scope

All waveforms and bias levels must be set with unit in circuit.

FIGURE 7 - DC CURRENT GAIN

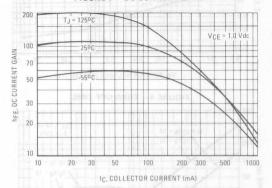


FIGURE 8 - "ON" VOLTAGES

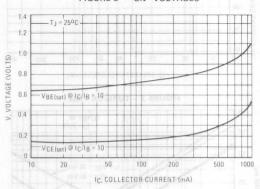


FIGURE 9 - ACTIVE-REGION SAFE OPERATING AREA

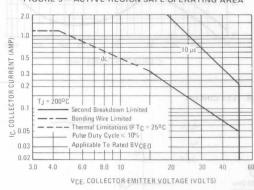
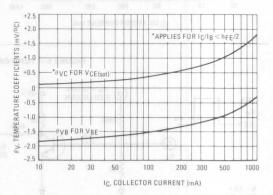


FIGURE 10 — TEMPERATURE COEFFICIENTS



There are two limitations on the power handling ability of a transistor: junction temperature and secondary breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 9 is based on $T_{J(pk)} = 200^{\circ}C$; T_{C} is variable depending on conditions. Pulse curves are valid for duty cycles of 10% provided $T_{J(pk)} \le 200^{\circ}$ C. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by secondary breakdown.



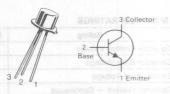
CASE 22-03, STYLE 1

MAXIMUM RATINGS

Rating	Symbol	2N6430	2N6431	Unit
Collector-Emitter Voltage	VCEO	200	300	Vdc
Collector-Base Voltage	VCBO	200	300	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current — Continuous	lc	50		mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	500 2.86		mW mW/°C
Total Device Dissipation (a $T_C = 25^{\circ}C$ Derate above $25^{\circ}C$	PD	1.8		Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C

2N6430 2N6431

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	louting					Sharra wie
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	озэ(на)У	2N6430 2N6431	V(BR)CEO	200 300	ostrelle officer <u>Areskor</u> onAdc <u>lg</u> = 1	Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mAdc, I _E = 0)	овоняву ^ў	2N6430 2N6431	V(BR)CBO	200 300	sa Br <u>ez</u> kdow n#dc <u>_lg</u> = 1	Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	ова(ла)У	Corons	V(BR)EBO	6.0 Voltage	nevobilsen8 i	Vdc
Collector Cutoff Current (V _{CB} = 160 Vdc) (V _{CB} = 200 Vdc)	060	2N6430 2N6431	ІСВО	=	0.1 0.1	μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	083	0.0000	IEBO	-	0.1 McGurent	μAdc
ON CHARACTERISTICS					a disense	B 3 1
DC Current Gain (I _C = 1.0 mAdc, V_{CE} = 10 Vdc) (I _C = 10 mAdc, V_{CE} = 10 Vdc) (I _C = 30 mAdc, V_{CE} = 10 Vdc)	384		hFE	25 40 50	200	
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)			VCE(sat)	aguilaV na	0.5	Vdc
Base-Emitter Saturation Voltage (IC = 20 mAdc, IB = 2.0 mAdc)	VBE(set)		VBE(sat)	sonilo)	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS			A complete his	Spinister St.	A PROPERTY OF	V
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 1	00 MHz)		f _T	50	500	MHz
Collector-Base Capacitance (VCB = 20 Vdc, I _E = 0, f = 1.0 MHz)	doO		C _{cb}	- 1 ,alay 68 60	4.0	pF

(1) Pulse Test: Pulse Width \leqslant 300 $\mu\text{s},$ Duty Cycle \leqslant 2.0%.

2N6430 2N6431

CASE 22-03, STYLE 1

MAXIMUM RATINGS

Rating	Symbol	2N6432	2N6433	Unit
Collector-Emitter Voltage	VCEO	200	300	Vdc
Collector-Base Voltage	VCBO	200	300	Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	Ic	500		mA
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	500 2.86		mW mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.8 10.3		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

2N6432 2N6433

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



3 Collector Base 1 Emitter

GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N3743 for graphs.

FLECTRICAL	CHARACTERICTICS	T 0500 1	and the state of the
FIFC. I BIC.AL	CHARACTERISTICS	1 A = 25% unless	otherwise noted I

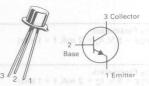
Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					noted a section of	o I consulti
Collector-Emitter Breakdown Voltage(1 (I _C = 1.0 mAdc, I _B = 0)	OBU(HB)*	2N6432 2N6433	V(BR)CEO	200 300	nAdc_lg = 0	Vdc
Collector-Base Breakdown Voltage (IC = 0.1 mAdc, IE = 0)	Овогнат	2N6432 2N6433	V(BR)CBO	200 300	nAde, lg = 0	Vdc
Emitter-Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	OBSIMBLY		V(BR)EBO	5.0	0 = gr _i obėc	Vdc
Collector Cutoff Current (V _{CB} = 160 Vdc) (V _{CB} = 200 Vdc)	080	2N6432 2N6433	ІСВО	_	0.25 0.25	μAdc
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)	(303)		IEBO	-	0.1	μAdc
ON CHARACTERISTICS						
DC Current Gain (IC = 1.0 mAdc, V _{CE} = 10 Vdc) (IC = 10 mAdc, V _{CE} = 10 Vdc) (IC = 30 mAdc, V _{CE} = 10 Vdc)	94 ¹		hFE	25	= 30V .06An NAdc Vi 0E = Adc T s = 150	10 OI - 51
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	VCE(Sat)		VCE(sat)	(ataArn 0	0.5	n () Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	(165) 310		VBE(sat)	(Jo Arti 0	g = 0.9 55A	Vdc Vdc
SMALL-SIGNAL CHARACTERISTICS					the same of the	and Commercial
Current-Gain — Bandwidth Product (IC = 10 mAdc, VCE = 20 Vdc, f = 2	20 MHz)		f _{TM} oor	50	500	MHz
Collector-Base Capacitance (VCB = 20 Vdc, I _E = 0, f = 1.0 MHz	654		C _{cb}	HM 0.1 = F	0 = 6.0 say	pF v

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMUM RATINGS BC BC BC Rating Symbol Unit 107 108 109 Collector-Emitter Voltage VCEO 45 25 25 Vdc Collector-Base Voltage VCBO 50 30 30 Vdc Emitter-Base Voltage 6 5 5 Vdc **VEBO** Collector Current - Continuous 0.2 Amp IC Total Device Dissipation a TA = 25°C Derate above 25°C PD 0.6 Watt mW/°C 2.28 Total Device Dissipation a T_C = 25°C a T_C = 100°C PD 1 Watt Derate above 25°C 6.67 mW/°C Operating and Storage Junction TJ. Tstq 65 to +200 °C Temperature Range THERMAL CHARACTERISTICS

CASE 22-03, STYLE 1 TO-18 (TO-206AA)

BC109,A,B,C



TRANSISTOR

NPN SILICON

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	175	°C/W

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

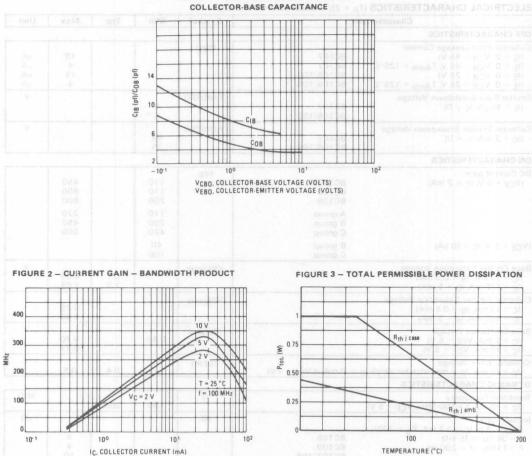
Characterist	ic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector Base Leakage Current (IE = 0, VCB = 45 V) (IE = 0, VCB = 45 V, TAmb = 125°C) (IE = 0, VCB = 25 V) (IE = 0, VCB = 25 V, TAmb = 125°C)	BC107 BC107 BC108/109 BC108/109	ICBO	5.1		15 4 15 4	nA µA nA µA
Emitter Base Breakdown Voltage (I _E = 10 μA, I _C = 0)	BC107 BC108/109	V(BR)EBO	6 5			V
Collector Emitter Breakdown-Voltage (IC = 2 mA, IE = 0)	BC107 BC108/109	V(BR)CEO	45 25			· V
ON CHARACTERISTICS			2			
DC Current gain (VCE = 5 V, IC = 2 mA)	BC107 BC108 BC109	7100 083V 7100 083V 7100 083V	110 110 200		450 800 800	
	A group B group C group		110 200 420		220 450 800	
$(V_{CE} = 5 \text{ V, } I_{C} = 10 \mu\text{A})$	B group C group		40 100			
Base Emitter Saturation Voltage (IC = 10 mA, IB = 0.5 mA) (IC = 100 mA, IB = 5 mA)	FIGURE 3 – TO	VBE(sat)	BANGWAE	0.7 1.0	0.83	SAUDI
Collector Emitter Saturation Voltage (IC = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5 mA)	orterna room (VCE(sat)			0.25	V
Base Emitter on Voltage (IC = 2 mA, VCE = 5 V) (IC = 10 mA, VCE = 5 V)	413	VBE(on)	0.55		0.70 0.77	V (20
Collector Knee Voltage (IC = 10 mA, IB = the value for which IC	= 11 mA at VCE = 1 V)	VCE(K)	TEST	0.4	0.6	V
DYNAMIC CHARACTERISTICS		2.92 = 1	HIDS	88. 11		
Transition Frequency (IC = 10 mA, f = 100 MHz, VCE = 5 V)	0.25	fΤ	150	300		MHz
Noise Figure $(V_{CE} = 5 \text{ V, I}_{C} = 0.2 \text{ mA, R}_{G} = 2 \text{ K}\Omega)$ F = 30 Hz to 15 kHz F = 1 kHz, \triangle F = 200 Hz	BC109 BC109 BC107/108	NF (As	er +) Tasanua :	- 001 100	4 4 10	dB 0

BC107,A,B,C, BC108,A,B,C, BC109,A,B,C

ELECTRICAL CHARACTERISTICS (continued) (Τ_Δ = 25°C unless otherwise noted.)

Characteris	tic		Symbol	Min	Тур	Max	Unit
Output Capacitance (VCB = 10 V, f = 1 MHz)			Cobo		68	4.5	pF IMIXAI
h_{21e} Parameters (VCE = 5 V, IC = 2 mA, f = 1 kHz)	BC107/108 BC109	BC BC 109 109 25 25	h21e	125 240	90s	500 900	allector E
	A group B group C group	30 30 6 8	YCBQ B0	125 240 450	9	260 500 900	i noraelle s 8-lettor
h_{11e} Parameters (VCE = 5 V, I _C = 2 mA, f = 1 kHz)	A group B group C group	80 80 80 80 80 80 80 80 80 80 80 80 80 8	h11e	1.6 3.2 6.0	ontinuous on TA ×	4.5 8.5 15	KΩ
h22e Parameters (VCE = 5 V, IC = 2 mA, f = 1 kHz)	A group B group C group	6 67 5 to + 200	h22e	D-BGE	= aT nomenut, a	30 60 110	µhos Berata

FIGURE 1 - EMITTER-BASE CAPACITANCE COLLECTOR-BASE CAPACITANCE



8C161,-6,10,16

MAXIMUM RATINGS

Rating T 3.1VTE SO EV BEAD	Symbol	BC 140	BC 141	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Base Voltage	Vсво	80	100	Vdc
Emitter-Base Voltage	VEBO	sav 7		Vdc
Collector Current - Continuous	IC	obA 1		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.8		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	3.7		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +200		or asc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	35	€ °C/W
Thermal Resistance, Junction to Ambient	RHJA	200	°C/W

BC140,10,16 BC141,10,16

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T	Δ = 25°C unless othe	erwise noted	Re	fer to 2N3	019 for grap	hs.
Characteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS				0.00-0.00-0.00	nove #5	
Collector Cutoff Current (IE = 0, VCE = 60 V)	T _A = 150°C		ICES	80	100	nA μA
Collector-Emitter Breakdown Voltage (ICES = 100 μ A, IE = 0)	BC140 BC141		V(BR)CES	80 100	37109 11009	V
Collector-Emitter Breakdown Voltage(1) $(I_C = 30 \text{ mA}, I_B = 0)$	BC140 BC141		V(BR)CEO	40 60	CES = -40 CES = -80	V
Emitter-Base Breakdown Voltage (I _E = 100 μA, I _C = 0)		081 181	V(BR)EBO	7	0 = gt ,Au 0	V.
ON CHARACTERISTICS	RAIV -		(Tee	estion nyiohi	Isan Bredline	hangatha.
DC Current Gain (1) (IC = 100 mA, VCF = 1 V)		087	S tol		2 = gl .Am	n. J.
for BC140, 141 for BC140, 141 G for BC140, 141 G	roup 10			40 63 100	400 160 250	B-retrim d
Collector-Emitter Saturation Voltage(1) (IC = 1 A, IB = 0.1 A)	n		VCE(sat)		(1080)	V

Base-Emitter Voltage(1) (IC = 1 A, VCE = 1 V)	VBE(on)	C180, BC1	2	V
SMALL SIGNAL CHARACTERISTICS	T Group 10	101-60, 801-6	101	
Gain Bandwidth Product (IC = 50 mA, VCE = 10 V, f = 20 MHz)	fT (I) e	50	and sather.	MHz
Input Capacitance (VEB = 0.5 V, I _C = 0, f = 1 MHz (no)46V	Cib	181	80	pF a
Capacitance (I _E = 0, V _{CB} = 10 V, f = 1 MHz)	Cop	TZIRETDAS	25	PF PF
Turn On Time (IC = 150 mA, I _{B1} = 7.5 mA)	ton SHAM OS	E1, V 01-	250	ns
Turn Off Time (IC = 150 mA, I _{B1} = I _{B2} = 7.5 mA)	toff	(shitV	850	ns s

(1) Pulsed: Pulse Duration = 300 μs, Duty Cycle = 1%.

BC140,10,16

MAXIMUM RATINGS

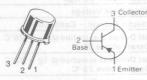
Rating 81 32 AO	Symbol	BC 160	BC 161	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Base Voltage	Vсво	40	60	Vdc
Emitter-Base Voltage	VEBO	30V 5		Vdc
Collector Current - Continuous	IC	abA 1		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.8		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	3.7		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +200		ot 9.6C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	35	°C/W
Thermal Resistance, Junction to Ambient	R _H JA	200	°C/W

BC160,-6,10,16 BC161,-6,10,16

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N4033 for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	To = 150.00		N GA = anv	0 = all
Collector Cutoff Current IE = 0, VCES = -40 V for BC160 VCES = -60 V for BC161 VCES = -40 V for BC160 T _{Amb} = 150 °C VCES = -60 V for BC161 T _{Amb} = 150 °C	10106	kdown Va D) kdown Va	- 100 - 100 - 100 - 100	nA μA
Collector Emitter Breakdown Voltage $I_C = -100~\mu\text{A}, I_E = 0$ for BC160 for BC161	V(BR)CES	- 40 - 60	se B reakdor LuA, I G = U	miller Br
$\frac{\text{Collector-Emitter Breakdown Voltage(1)}}{\text{IC} = -10 \text{ mA, IB} = 0}$ for BC160 for BC161	V(BR)CEO	-40 -60	ACTERISTIC Galo.(1) UNA. VOE 3	O Curent
Emittor-Base Breakdown Voltage IE = -100 µA, IC = 0		128 161		V
ON CHARACTERISTICS	81 quelo (141 joi	A DE NA		
DC Current Gain(1) $I_C = -100 \text{ mA, } V_{CE} = -1 \text{ V} \\ \text{for BC160, BC161 Group 6} \\ \text{for BC160, BC161 Group 10} \\ \text{for BC160, BC161 Group 16} \\ \\$	hFE 83 Tt	40 40 63 100	400 100 160 250	10 3 0 25 10 3 0 25
Collector-Emitter Saturation Voltage(1) (I _C = -1 A, I _B = -0.1 A)	VCE(sat)		Am. Am.	V ₁
Base-Emitter Voltage(1) (IC = -1 A, VCE = -1 V)	VBE(on)		0 = 51 V 8 -1.7	e V/
SMALL SIGNAL CHARACTERISTICS		SHM I'm	Vor e gov	(Legal)
Gain Bandwidth Product (I _C = -50 mA, V _{CE} = -10 V, f = 20 MHz	fT	50	en Le ral Ain t	MHz
Input Capacitance (VEB = -10 V, f = 1 MHz)	Cib	82 = 7.6	180	TH(pFu
Output Capacitance ($V_{CB} = -10 \text{ V}$, $I_E = 0$, $f = 1 \text{ MHz}$)	Cobo	008 = 0	ulse Duratio 30	b pE
Turn On Time (I _C = -100 mA, I _{B1} = -5 μ A)	Ton		500	ns
Turn Off Time (I _C = -100 mA, I _{B1} = I _{B2} = -5 μ A)	Toff		650	ns

⁽¹⁾ Pulsed: Pulse Duration = 300 μs, Duty Cycle = 1%.

MAXIMUM RATINGS TO THE STATE OF

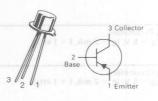
Rating	Symbol	BC 177	BC 178	BC 179	Unit
Collector-Emitter Voltage	VCEO	45	25	20	Vdc
Collector-Emitter Voltage	VCES	50	30	25	Vdc
Collector-Base Voltage	Vсво	50	30	25	Vdc
Emitter-Base Voltage	VEBO	30 5			Vdc
Collector Current - Continuous	IC		0.2		Amp
Total Device Dissipation @TA = 25°C Derate above 25°C	PD		0.6 2.28		Watt mW/°C
Total Device Dissipation $@T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above $25^{\circ}C$	PD	6.67		Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +200		°C (10	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	175	°C/W

BC177,A,B,C BC178,A,B,C BC179,A,B,C

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteris	tic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector Emitter Leakage Current (VCE = 20 V, IE = 0) (VCE = 20 V, IE = 0, TAmb = 125°C)		CES			100 4	nΑ μΑ
Collector Base Breakdown Voltage (IC = 10 μ A)	BC177 BC178 BC179	V(BR)CBO	50 30 25			V
Collector Emitter Breakdown Voltage (I _C = 2 mA, I _E = 0)	BC177 BC178 BC179	V(BR)CEO	45 25 20			V
Emitter Base Breakdown Voltage (I _E = 10 μA, I _C = 0)		V(BR)EBO	5			٧
ON CHARACTERISTICS						
DC Current Gain (I _C = 2 mA, V _{CE} = 5 V)	BC177 BC178 BC179 A Group B Group C Group	hFE	120 120 180 120 180 380		460 800 800 220 460 800	
Collector Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5 mA)		vCE(sat)			0.2 0.6	V
Base Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.5 mA) (I _C = 100 mA, I _B = 5 mA)		VBE(sat)		0.7 0.9	0.8	V
Base Emitter on Voltage (IC = 2 mA, VCE = 5 V)		VBE(on)	0.6		0.75	V
Collector Knee Voltage (IC = 10 mA, IB = the value for which (IC = 11 mA, at VCE = 1V)		VCE(K)		0.4	0.6	V
DYNAMIC CHARACTERISTICS						
Transition Frequency (VCE = 5 V, IC = 10 mA, f = 50 MHz)		fT	200	300		MHz
Noise Figure (VCE = 5 V, IC = 0.2 mA, Rg = 2 K Ω) F = 30 Hz to 15 kHz F = 1 kHz, F = 200 Hz	BC179 BC179 BC177/178	NF			4 4 10	dB

Unaracteris	SUC		Symbol	Min	Тур	Max	Unit
Output Capacitance (VCB = 10 V, f = 1 MHz)	siaU	8C 8C	Cobo		3.5	4	nF
h21e Parameters	BC177	los as l	h21e	125	bgat	500	sizello
$(V_{CE} = 5 \text{ V}, I_{C} = 2 \text{ mA}, f = 1 \text{ kHz})$	BC178 BC179		Vess as	125	501	900	utpalle
	A Group		VCRO SC	125	91	260	- otsalic
	B Group C Group		OBBV	240 450		500 900	e rantin
h11e Parameters	Q Q Q	\$ 47	h11e		sconunus	a tualun	ΚΩ
(VCF = 5 V, IC = 2 mA, f = 1 kHz)	A Group		nq	1.6	= AT Sino	4.5	pive Clist
1.05	B Group			3.2	J. 10 11	8.5	E HATEU
	C Group		-19	6.0	= aT sa no	15.0	Mad Day
h22e Parameters			h22e	3°001	13T		μmhos
(VGE = 5 V, IC = 2 mA, f = 1 kHz)	A Group					30	6 Water
19000071	B Group C Group		Fur Tate - 6		roitomil. s	60 110	o titares

	О Стопр		nonality is a second

BCY58,-VII,VIII,IX,X BCY59,-VII,VIII,IX,X

Characteristic

Thermal Resistance, Junction to Case

MAXIMUM RATINGS

Rating	Symbol	BC 393	BC 394	Unit
Collector-Emitter Voltage	VCEO	180	180	Vdc
Collector-Base Voltage	Vсво	180	180	Vdc
Emitter-Base Voltage	VEBO	6	6	Vdc
Collector Current - Continuous	Ic	11.00	.5	Amp
Total Device Dissipation @TA = 25°C Derate above 25°C	PD	0.4		Watt mW/°C
Total Device Dissipation @ T _C = 25°C T _C = 100°C	PD	1º Wyen	.5	Watt
Derate above 25°C			2000.0	mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to	+200	°C
THERMAL CHARACTERISTICS			20	eB/l

BC393 BC394 PNP 3 Collector 2 Base 1 Emitter 1 Emitter CASE 22-03, STYLE 1 TO-18 (TO-206AA) HIGH VOLTAGE TRANSISTOR

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Symbol

RHJC

Max

125

Unit

°C/W

Characterist	tic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	10211190	1 2071			2017	21837046	8 H2 25
Collector-Emitter Breakdown Voltage (I _C = 10 mA, I _B = 0)	VIBRICED	86758	V(BR)CEO	180		in the la	Vdc
Collector-Base Breakdown Voltage (I _C = 100 µAdc, I _E = 0)		ila	V(BR)CBO	180	siloV nwo	ase Break	Vdc
Emitter-Base Breakdown Voltage (IE = 100 µAdc, IC = 0)		eavno	V(BR)EBO	6	Inan	(iii) Horu2	Vdc
Collector Cutoff Current (VCB = 100 V, IE = 0)	vani.	BCY59 BCY58	ІСВО	V 5.0 - 3	100°C, W	50	nA
Collector-Emitter Cutoff (VCE = 100 V, IB = 0) (T _{Amb} = 150°C)	lots	BCV58	ICEO	V E O = 3	18021 1802	50	μА
ON CHARACTERISTICS (1)		66,119			1 001	At V P	TO VI
DC Current Gain (IC = 10 mA, VCE = 10 V)	ONT		hFE	50	100	N/ a	= gaV
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1 mAdc)	and		VCE(sat)		0.15	0.3	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1 mAdc)		VIII. BCY58-VIII	VBE(sat)		0.7	0.9	Vdc
DYNAMIC CHARACTERISTICS		X BEYSB-X	BCYSS				
Current Gain Bandwidth Product (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 20 N	1Hz)	VII. BCY58 VIII	fτ	50	110	200	MHz
Output Capacitance (I _E = 0, V _{CB} = 20 Vdc, f = 1 MHz)		X. BCYS8.X VII. BCYS8.VII	Cobo		3.5	7.46	pF
Input Capacitance (IC = 0, VEB = 0.5 Vdc, f = 1 MHz)		VIII. BCYSS-VIII IX, BCYSS-IX	Cib		75		pF
Turn-On Time (I _{B1} = 10 mA, I _C = 50 mAdc, V _{CC} = 100) Vdc))	VII. BCY58 VII.	ton	(100	V atoAm 0	ns
Turn-Off Time (IB2 = 10 mAdc, IC = 50 mAdc, VCC = 1	100 Vdc))	IX, BCYSB-IX X, BCYSB-X	toff		400		ns

* Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.



MAXIMUM RATINGS

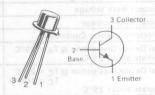
Rating	Symbol	BCY 58	BCY 59	Unit
Collector-Emitter Voltage	VCEO	32	45	Vdc
Collector-Emitter Voltage (RBE = 10 Ohms)	VCES	32	45	Vdc
Emitter-Base Voltage	VEBO	bbV	7 981	Vdc
Collector Current - Continuous	IC	0	.2	Amp
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.6		Watt mW/°C
Total Device Dissipation @ T _C = 25°C T _C = 100°C Derate above 25°C	PD	HEW 6.	67	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to	+200	or eg

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	150	°C/W
Thermal Resistance, Junction to Ambient	RHJA	450	°C/W

BCY58,-VII,VIII,IX,X BCY59,-VII,VIII,IX,X

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



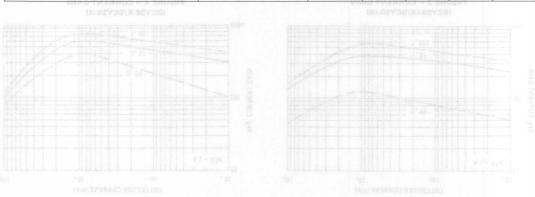
TRANSISTOR

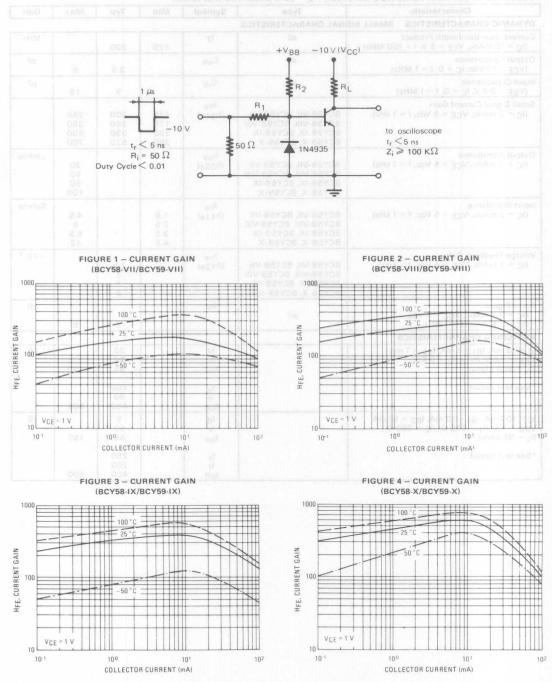
NPN SILICON

			REPORTS ALL DATE OF THE PARTY OF	
ELECTRICAL CHARA	CTERISTICS (TA = 25°C	The state of the s		
ELECTRICAL CHARA	CIEDIO II CO II A = 25°C	unless otherwise noted.)		

Characteristic	THE PERSON NAMED IN	Туре	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	-				8011	OTHER TOWN	
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IC = 0)	0 14834	BCY58 BCY59	V(BR)CEO	32 45	(0	e gr Am	Vdc
Emitter-Base Breakdown Voltage (IE = 1μAdc, IC = 0)	piss).	all	V(BR)EBO	7	(0.=	al share	Vdc
(VCE = 32 V) (VCE = 45 V)	1(86)V 1804	BCY58 BCY59	ICES		0.2	10 10 20	nAdc uAdc
(VCE = 32 V, T _A = 100°C, V _{BE} = 0.2 V) (VCE = 45 V, T _A = 100°C, V _{BE} = 0.2 V) (VCE = 32 V, T _A = 150°) (VCE = 45 V, T _A = 150°)	0.50(BCY58 BCY59 BCY58 BCY59	ICES	io par e	0.2 0.5		μAdc
Emitter Base Cutoff Current (VEB = 5 V)	1311	all	IEBO		N/Dr	10	nAdc
ON CHARACTERISTICS				000	lel/ amilesia	a 2 satture	- Gaallati
DC Current Gain (IC = $10 \mu Adc$, $V_{CE} = 5 Vdc$) (IC = $10 \mu Adc$, $V_{CE} = 5 Vdc$) (IC = $10 \mu Adc$, $V_{CE} = 1 Vdc$) (IC = $100 \mu Adc$, $V_{CE} = 1 Vdc$)	BCY5 BCY5 BCY5 BCY5 BCY5 BCY5 BCY5 BCY5	9-VII, BCY58-VII 9-VIII, BCY58-VIII 9-IX, BCY58-IX 9-XI, BCY58-X 9-VII, BCY58-VII 9-VIII, BCY58-VII 9-IX, BCY58-IX 9-VII, BCY58-VII 9-VIII, BCY58-VII 9-X, BCY58-IX 9-X, BCY58-X 9-VIII, BCY58-VII 9-VIII, BCY58-VII 9-VIII, BCY58-VII	hFE (sR)	20 40 100 120 180 250 380 80 120 160 240 40 45 60	220 300 170 250 350 500 190 260	220 310 460 630 400 630 1000	or colling of the col
004		9-X, BCY58-X	((pbV 00)	60	Am 08 =	phabAm 0	(192
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 2.5 mAdc) (I _C = 10 mAdc, I _B = 0.25 mA)		all	VCE(sat)	0.15 0.05	0.30 0.12	0.70 0.35	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.25 mA) (I _C = 100 mA, I _B = 2.5 mA)		all	VBE(sat)	0.6 0.75	0.70 0.90	0.85	Vdc
Base-Emitter on Voltage (IC = 2 mAdc, VCE = 5 Vdc)		all	VBE(on)	0.55	0.62	0.70	Vdc

Characteristic	Type	Symbol	Min	Тур	Max	Unit
DYNAMIC CHARACTERISTICS SMALL SIG	GNAL CHARACTERISTICS					
Current Gain-Bandwidth Product (IC = 10 mAdc, VCE = 5 V, f = 100 MHz)	all	fŢ	125	200		MHz
Output Capacitance (VCE = 10 Vdc, IC = 0, f = 1 MHz)	all	Cob		3.5	6	pF
Input Capacitance (VBE = 0.5 V, IC = 0, f = 1 MHz)	all	Cib	94	8	15	pF
Small Signal Current Gain (IC = 2 mAdc, VCE = 5 Vdc, f = 1 kHz)	BCY58-VII, BCY59-VII BCY58-VIII, BCY59-VIII BCY58-IX, BCY59-IX BCY58-X, BCY59-X	h _{fe} (h _{21e})	125 175 250 350	200 260 330 520	250 350 500 700	
Output Admittance (IC = 2 mAdc, VCE = 5 Vdc, f = 1 kHz)	BCY58-VII, BCY59-VIII BCY58-VIII, BCY59-VIII BCY58-IX, BCY59-IX BCY58-X, BCY59-X	h _{oe} (h _{22e})	10.0	R) Suty Cycle	30 50 60 100	μmhos
Input Impedance (IC = 2 mAdc, VCE = 5 Vdc, f = 1 kHz)	BCY58-VII, BCY59-VII BCY58-VIII, BCY59-VIII BCY58-IX, BCY59-IX BCY58-X, BCY59-X	hie (h11e)	1.6 2.5 3.2 4.5		4.5 6 8.5 12	Kohms
Voltage Feedback Ratio (IC = 2 mAdc, VCE = 5 Vdc, f = kHz)	BCY58-VII, BCY59-VII BCY58-VIII, BCY59-VIII BCY58-IX, BCY59-IX BCY58-X, BCY59-X	h _{re} (h12e)	HV-eeys	1.5 2 2 3	FIGU (I	×10 4
Noise Figure (I _C = 0.2 mAdc, V _{CE} = 5 Vdc, R _S = 2 Kohms, f = 1 kHz)	all	NF		2-	6	dB
SWITCHING CHARACTERISTICS	T 3 TU	MIT II				
$I_{C}=10$ mA, $I_{B1}=1$ mA, $I_{B2}=1$ mA $V_{BB}=3.6$ V, $R_{1}=R_{2}=5$ K Ω . $R_{L}=990$ ohms	001 6	td t _r t _{on}		35 50 85	150	nS
*See test circuit.	3	t _s t _f t _{off}		400 80 480	800	
I_C = 100 mA, I_{B1} = 10 mA, I_{B2} = 10 mA V_{BB} = 5 V, R_1 = 500 Ω , R_2 = 700 Ω R_L = 98 ohms	191 -01	td tr ton	Home TARRAGO	5 50 55 250	150	nS
dec test circuit.		t _f		200 450	800	





BCY58,-VII,VIII,IX,X, BCY59,-VII,VIII,IX,X

FIGURE 5 - SATURATION VOLTAGE

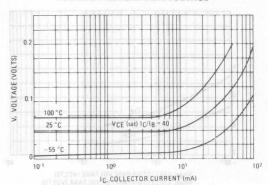


FIGURE 6 - SATURATION VOLTAGE

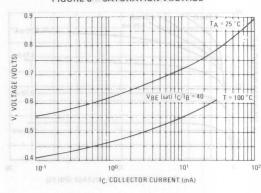


FIGURE 7 - INPUT CHARACTERISTIC
(COMMON EMITTER CIRCUIT)

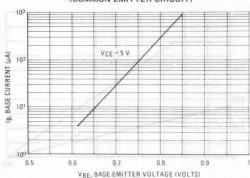


FIGURE 8 - OUTPUT CHARACTERISTIC

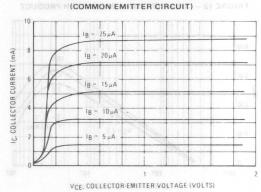


FIGURE 9 – OUTPUT CHARACTERISTIC (COMMON EMITTER CIRCUIT)

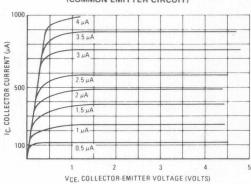
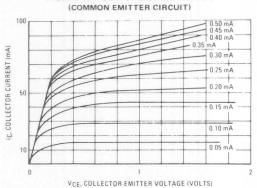
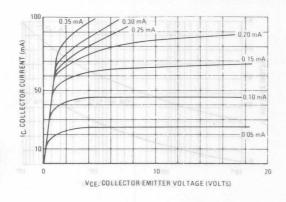


FIGURE 10 – OUTPUT CHARACTERISTIC





CIB

COB

VCBO, COLLECTOR BASE VOLTAGE (VOLTS)

VEBO, COLLECTOR EMITTER VOLTAGE (VOLTS)

FIGURE 13 - CURRENT GAIN - BANDWIDTH PRODUCT

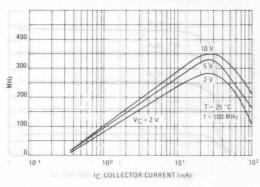
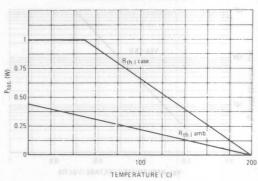
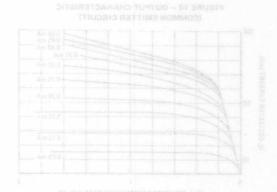
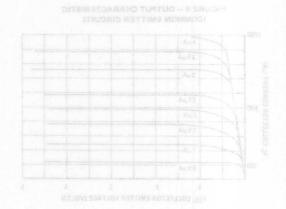


FIGURE 14 - TOTAL PERMISSIBLE POWER
| DISSIPATION (BCY58/BCY59)







MAXIMUM RATINGS

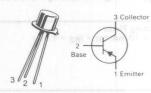
Rating DES	Symbol	BCY 70	BCY 71	BCY 72	Unit
Collector-Emitter Voltage	VCEO	40	45	25	Vdc
Collector-Base Voltage	VCBO	50	45	25	Vdc
Emitter-Base Voltage	VEBO		5		Vdc
Collector Current - Continuous	IC		0.2		Amp
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		360 2.06		mWatt mW/°C
Total Device Dissipation @ $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above 25°C	PD		0.6 4.0		mWatt
Operating and Storage Junction Temperature Range	TJ, Tstg	-65	to +	-200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	175	°C/W

BCY70 BCY71 BCY72

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



TRANSISTOR

PNP SILICON

Refer to 2N3798 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector Emitter Breakdown Voltage (I _C = 2 mA, I _B = 0)	BCY70 BCY71 BCY72	V(BR)CEO	40 45 25			Vdc
Collector Base Leakage Current (IE = 0, VCB = 50 V) (IE = 0, VCB = 45 V) (IE = 0, VCB = 25 V)	BCY70 BCY71 BCY72	ICBO			0.5 0.5 0.5	μΑ
(I _E = 0, V _{CB} = 40 V, T _{Amb} = 100°C) (I _E = 0, V _{CB} = 40 V, T _{Amb} = 100°C) (I _E = 0, V _{CB} = 20 V, T _{Amb} = 100°C)	BCY70 BCY71 BCY72				2 2 2	
(I _E = 0, V _{CB} = 40 V) (I _E = 0, V _{CB} = 40 V) (I _E = 0, V _{CB} = 20 V)	BCY70 BCY71 BCY72				10 50 50	nA
Emitter Base Leakage Current (VEB = 5 V, IC = 0) (VEB = 4 V, IC = 0) (VEB = 4 V, IC = 0, TAmb = 100°C)		IEBO			0.5 10 2	μΑ nΑ μΑ
Collector Emitter Leakage Current (VCE = 50 V, VBE = 3 V)	BCY70	CEX			20	nA
ON CHARACTERISTICS						
DC Current Gain (V _{CE} = 1 V, I _C = 10 μA) (V _{CE} = 1 V, I _C = 100 μA)	BCY71 BCY70	HFE	40 40			
$(V_{CE} = 1 \text{ V, } I_{C} = 1 \text{ mA})$	BCY71 BCY70 BCY71 BCY72		80 45 90 40			
$(V_{CE} = 1 V, I_{C} = 10 mA)$	BCY70 BCY71 BCY72		50 100 50		600	
$(V_{CE} = 1 \ V, I_{C} = 50 \ mA)$	BCY70		15			
Base Emitter Saturation Voltage (I _C = 50 mA, I _B = 5 mA) (I _C = 10 mA, I _B = 1 mA)	BCY70/71 BCY70/71	VBE(sat)	0.6		1.2	V
Collector Emitter Saturation Voltage ($I_C = 50 \text{ mA}, I_B = 5 \text{ mA}$) ($I_C = 10 \text{ mA}, I_B = 1 \text{ mA}$)		VCE(sat)			0.50 0.25	V

BCY70, BCY71, BCY72

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
DYNAMIC CHARACTERISTICS					200	ATTA TO SAI	10.000
Transition Frequency (I _C = 10 mA, f = 100 MHz, V _{CE} = 20 V) (I _C = 100 μ A, f = 10.7 MHz, V _{CE} = 20 V)		YBCVBCV	28 100 my 2	250 15	20	Rati	MHz
Noise Figure (VCE = 5 V, IC = 100 μ A, Rg = 2 K Ω , 30 to	15 kHz at - 3 d BCY70/72 BCY71	B points)	VCBO SE		9 gg 6	6	dB 9
Switching Times	gniA	0.2	1 01		atrountico	priest - C	ns
(IC = 10 mA, I _{B1} = I _{B2} = 1 mA)	BCY70/72 BCY70/72 BCY70/72 BCY70/72 BCY70/72 BCY70/72	360 2.06 0.6 4.0	ton 14 toff td tr ts tf		- 3T @ no	420	otal Divisional Division Delate S
h parameters $(VCE = 10 \text{ V, I}_{C} = 1 \text{ mA, f} = 1 \text{ kHz})$	BCY71	002+010	h12e h21e	100	e Junction	20×10 ⁴	peruing Tempara IA (193H
PNP SILICON		Max	h22e	10	oliteire	12	μs ΚΩ
Common Base Output Capacitance (VCB = 10 V, IE = 0, f = 1 MHz)			Cob	1,111	N ROLLONG	6	pF
Input Capacitance (VBE = 1 V, IC = 0, f = 1 MHz	e noted.)	ess otherwise	Cib A	STICS	RACTER	AHO JAO	pF

	80 100 50		

MAXIMUM RATINGS

Rating 174	Symbol	BCY 78	BCY 79	Unit
Collector-Emitter Voltage	VCEO	32	45	Vdc
Collector-Emitter Voltage (RBE = 10 Ohms)	VCES	32	45	Vdc
Emitter-Base Voltage	VEBO		5	Vdc
Collector Current - Continuous	IC die	0	.2	Amp
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1	.6 28	Watt mW/°C
Total Device Dissipation @ $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above 25 °C	PD	6.	67	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to	+200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	150	°C/W
Thermal Resistance, Junction to Ambient	RHJA	450	® °C/W

BCY78,-VII,VIII,IX,X BCY79,-VII,VIII,IX,X

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	day	Type	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					(sPol 1	= Lemno	Rs = 21
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IC = 0)	- Land	BCY78 BCY79	V(BR)CEO	32 45	CTERNSTN		Vdc
Emitter-Base Breakdown Voltage (IE = 2 µAdc, IC = 0)	003	all	V(BR)EBO	5	ात्र ते -	V. Ri = R.v.	Vdc 000
Collector Cutoff Current (VCE = 32 V) (VCE = 45 V) (VCE = 32 V, TA = 100 °C, VBE = 0.2 V) (VCE = 45 V, TA = 100 °C, VBE = 0.2 V) (VCE = 25 V, TA = 150 °) (VCE = 35 V, TA = 150 °)	bf yi	BCY78 BCY79 BCY78 BCY79 BCY78 BCY79	ICES ICEX ICES	Am 0f = 0.09	0.2 0.2 0.2 0.2 0.5		nA μAdc μAdc
Emitter Base Cutoff Current (VEB = 4 V)	lejt.	all	IEBO			20	nA taal taa
ON CHARACTERISTICS	Nal						
DC Current Gain			hFE				

DC Current Gain		hFE				
$(I_{C} = 10 \mu Adc, V_{CE} = 5 Vdc)$ $(I_{C} = 2 mAdc, V_{CE} = 5 Vdc)$ $(I_{C} = 10 mAdc, V_{CE} = 1 Vdc)$ $(I_{C} = 100 mAdc, V_{CE} = 1 Vdc)$	BCY79-VII, BCY78-VII BCY79-VIII, BCY78-VII BCY79-IX, BCY78-IX BCY79-X, BCY78-X BCY79-VII, BCY78-VII BCY79-VIII, BCY78-VII BCY79-IX, BCY78-IX BCY79-VII, BCY78-VII BCY79-VII, BCY78-VII BCY79-VII, BCY78-VII BCY79-IX, BCY78-IX BCY79-VII, BCY78-IX BCY79-VII, BCY78-VII	··FE	30 40 100 120 180 250 380 80 120 160 240 45	145 220 300 170 250 350 500 190 260 380 550	220 310 460 630 400 630 1000	
	BCY79-IX, BCY78-IX BCY79-X, BCY78-X		60 60			
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 2.5 mAdc) (I _C = 10 mAdc, I _B = 0.25 mA)	all	VCE(sat)	0.15 0.05	0.30 0.12	0.80 0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.25 mA) (I _C = 100 mA, I _B = 2.5 mA)	all	VBE(sat)	0.6 0.75	0.70 0.90	0.85 1.2	Vdc
Base-Emitter on Voltage (IC = 2 mAdc, VCE = 5 Vdc)	all	VBE(on)	0.60	0.62	0.75	Vdc

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

		acteristic		1 17	Туре	VOR VS	Symbol	Min	Тур	Max	Unit
DYNAMIC	CHARAC	TERISTICS	SMALL	SIGNAL CH	ARACTE	RISTICS					
	nin-Bandwi mAdc, VCE		t 100 MHz)	3	all	2 45	ft/80V	180	300	lov return	MHz
Output Car (VCE = 1	o Vdc, IC =	= 0, f = 1 N	1Hz)		all	3	Cob		3.5	familio 0	pF
nput Capa (VBE = 0	ocitance 0.5 V, I _C =	0, f = 1 MF	Hz)	q	all	0.2	Cib		2001 Mino	15	pF
	nal Current nAdc, VCE			BCY78 BCY78	-VII, BCY -VIII, BCY -IX, BCY -X, BCY	Y79-VIII 79-IX	hfe (h21e)	25°C	200 260 330 520	ove 25°C Over 25°C over 25°C	prate and all of the control of the
(IC = 2 n	nAdc, VCE	= 5 Vdc, f		BCY78 BCY78	-VII, BCY -VIII, BC' -IX, BCY -X, BCY	Y79-VIII 79-IX	hie (h _{11e})	1.6 2.5 3.2 7.5	e Junction (ERISTICS eristic	4.5 6 8.5 12	Kohm sagans JAMA3
	edback Ra nAdc, VCE		= 1 kHz)	BCY78 BCY78	-VII, BCY -VIII, BC' -IX, BCY -X, BCY	Y79-VIII 79-IX	h _{re} (h12e)	Inside/	1.5 2 2 2 3	estance.	×10
Noise Figu	re 2 mAdc, V	F = 5 Vdc	nitA	Symbol	all	sqyT	NF		acteristic	Char	dB
	Kohms, f =				dii				2800	8196	RAHDE
SWITCHIN	NG CHARA	CTERISTI	cs s	V(BR)CEO		BCY78		egsti	oV nwobils	miller Bre	3-notaell
	A, I _{B1} = 1 n V, R ₁ = R; ohms		l mA	V(8R)EBO		lle	td t _r t _{on}	9	35 50 85	150	nS
See test	circuit.	0.2		loes		8CY78 8CY79 8CY79	t _s t _f t _{off}	W S D = =	400 80 480	800) - otosii 2 - 30\ 3 - 30\ 2 - 20\
	nA, IB1 = 1 /, R ₁ = 500 hms			lces		8CY78 8CY78 8CY79	t _d t _r t _{on}	(V 2.0 = 3	5 50 55	150	nS
*See test o	circuit.			0831		flis.	ts tf toff		250 200 450	12 800 J	Nitrer San VEB 1
	220 310 460 660	145 220 300 170 250 350 500	30 40 100 120 180 250 380	334		VII. BCY7 -VIII. BCY7 -X. BCY7 -VII. BCY7 -VIII. BCY7	BCY79 BCY79 BCY79 BCY79 BCY79 BCY79 BCY79 BCY79			Sain Ada, Veg Ada, Veg	

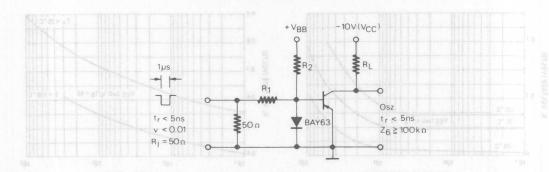


FIGURE 1 - CURRENT GAIN (BCY78-VII/BCY79-VII)

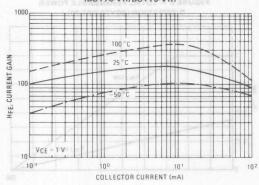


FIGURE 2 - CURRENT GAIN (BCY78-VIII/BCY79-VIII)

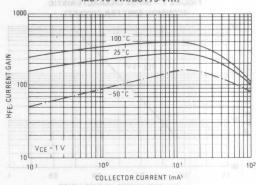


FIGURE 3 - CURRENT GAIN

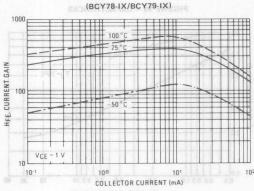


FIGURE 4 – CURRENT GAIN (BCY78-X/BCY79-X)

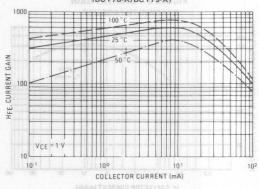


FIGURE 5 - SATURATION VOLTAGE

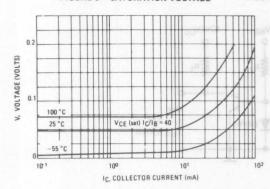


FIGURE 6 - SATURATION VOLTAGE

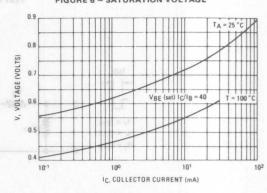


FIGURE 7 - INPUT CHARACTERISTIC

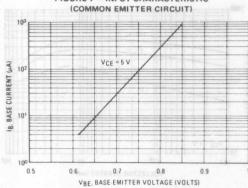


FIGURE 8 - TOTAL PERMISSIBLE POWER

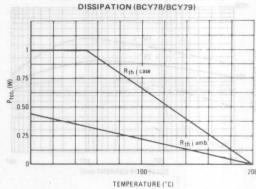


FIGURE 9 - CURRENT GAIN

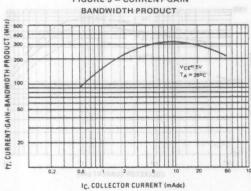
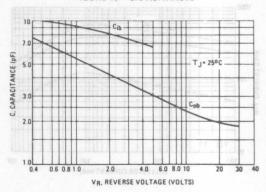


FIGURE 10 - CAPACITANCES



BFW43

MAXIMUM RATINGS

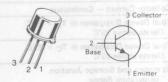
(AASORating BT-OT	Symbol	BF 257	BF 258	BF 259	Unit	
Collector-Emitter Voltage	VCEO	160	250	300	Vdc	
Collector-Emitter Voltage	VCER	160	250	300	Vdc	
Collector-Base Voltage	Vсво	160	250	300	Vdc	
Emitter-Base Voltage	VEBO		5.0	1.0	Vdc	
Collector Current - Continuous	IC.		0.1	(B, 6)	Adc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	NE.	0.8 4.57	1.4	Watt mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	P. C.	5.0 28.6	10.50	Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	- 65	to +	200	°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	35	°C/W

BF257 BF258 BF259

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



HIGH VOLTAGE TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) \$ = AT 2017213370 ARAHO JADIRTOR 13

tinu xsM oyl Character	ristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				STICS	RETER	MO 110
Collector-Emitter Breakdown Voltage (IC = 30 mAdc, I _B = 0)	BF257 BF258 BF259	V(BR)CEO	160 250 300	(reakdown 0) akdowa Vo Is = 0)	Southers MA_1g = 8 are Bri 00 arkdo	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	BF257 BF258 BF259	V(BR)CBO	160 250 300		Sasa Breat 00 pade. Culoff C	- 3i/_
Emitter-Base Breakdown Voltage (IE = 100 µAdc, IC = 0)	ICEO	V(BR)EBO	5.0	utoff Curr	restand-	Vdc
Collector Cutoff Current (V _{CB} = 100 Vdc, I _E = 0) (V _{CB} = 200 Vdc, I _E = 0) (V _{CB} = 250 Vdc, I _E = 0)	BF257 BF258 BF259	ICBO	-	(F) (D) T	50 50 50	nAdd
ON CHARACTERISTICS				(V 01 = 9	O MAR. YO	- 31
DC Current Gain (IC = 30 mAdc, VCE = 10 Vdc)	VCE(sat)	hFE	25	80	Emitter S	Zo Hector
Collector-Emitter Saturation Voltage (IC = 30 mAdc, IB = 6.0 mAdc)	(lise)38V	VCE(sat)	98	0.1	1.0	Vdc
DYNAMIC CHARACTERISTICS			10	DAMI L	DUMIN V	
Current Gain Bandwidth Product (IC = 30 mAdc, VCE = 10 Vdc, f = 10	O MHz)	fT	191	110	Sam Band	MHz
Reverse Transfer Capacitance (VCB = 30 Vdc, IE = 0, f = 500 kHz)	edo ³	C _{re}	191513	3.5	apecitanc	pF
Collector-Base Capacitance (VCB = 10 Vdc, IE = 0, f = 500 kHz)	nol	C _{cb}	Jaziel	5.5	5 18.3 5 mi	no ipF



MAXIMUM RATINGS

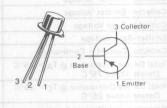
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	150	Vdc
Collector-Base Voltage	VCBO	150	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	lc lc	0.1	Adc
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	0.4 2.66	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.4 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R _θ JC	125	°C/W
Thermal Resistance, Junction to Ambient	R_{θ} JA	438	°C/W

BFW43

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



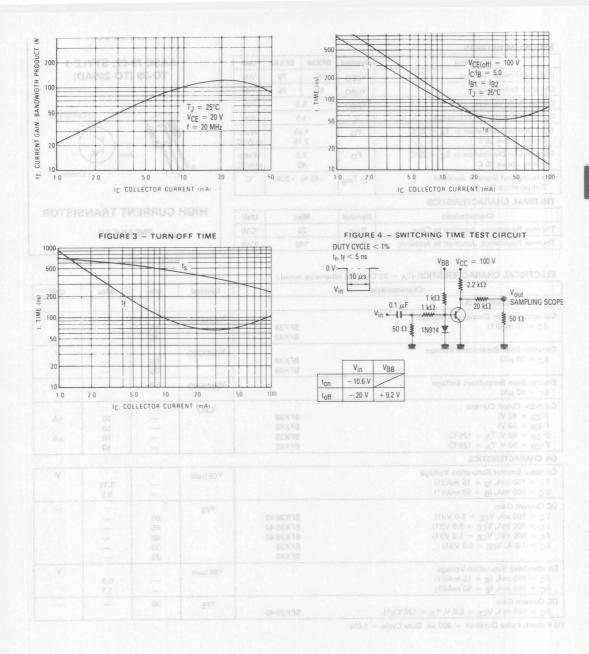
HIGH VOLTAGE TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) S = ATI 20172183T0A8AH0 JADIRTO3J3

Characteristic Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			STICS		
Collector-Emitter Breakdown Voltage (I _C = 2 mA, I _B = 0)	V(BR)CEO	150	ireakdown g = 0)	Lienims . Omano.	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	V(BR)CBO	150			Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	V(BR)EBO	6	akdown w E = 0)	DO LAGG.	Vdc
Collector Cutoff Current (VCB = 100 V, IE = 0)	ее Ісво		u vi	10	nA
Collector-Emitter Cutoff Current (VCB = 100 V, IB = 0) T,A = 125°C	ICEO		(0 = 0	36A G	μА
ON CHARACTERISTICS (1)	182287		(0 = 31	pull DOT	85V)
DC Current Gain (IC = 1 mA, VCE = 10 V) (IC = 10 mA, VCE = 10 V)	ad Shee	40 40		200 Vdc 250 Vdc PACTEBL	CYCB ON CHA
(I _C = 10 μA, V _{CE} = 10 V, T _A = -55°C)	Vor		30	India/Lin	V/1
Collector-Emitter Saturation Voltage (IC = 10 mAdc, Ig = 1 mAdc)	VCE(sat)		0.15	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1 mAdc)	VBE(sat)	(dc)	0.7	0.9	Vdc
DYNAMIC CHARACTERISTICS		fau	audin Prod	donal nist	inerran:
Current Gain Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f = 10 MHz)	fTzHM	60	110	200	MHz
Output Capacitance (IE = 0, VCB = 20 Vdc, f = 1 MHz)	C _{obo}	(2)6/ (00)	3.5	35 V 08	aopF
Turn On Time (IB1 = 10 mA, IC = 50 mAdc, VCC = 100 Vdc)	t _{on}	(sHal-006	100	LabV 01	ns
Turn Off Time (IB2 = 10 mAdc, IC = 50 mAdc, VCC = 100 Vdc)	toff		400		ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2%.



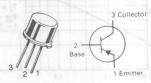
MAXIMI IM BATINGS

Non a Rating	Symbol	BFX38	BFX40	Unit
Collector-Emitter Voltage	VCEO	55	75	Vdc
Collector-Base Voltage	VCBO	55	75	Vdc
Emitter-Base Voltage	VEBO	5	5.0	
Collector Current — Continuous	Ic	1.0		Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	1.25 7.15		Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	7.0 40		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R_{θ} JC	20	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	140	°C/W

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



HIGH CURRENT TRANSISTOR

PNP SILICON

Refer to 2N4405 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	9 ₀ 1.0				11	
Collector-Emitter Breakdown Voltage (I _C = 10 mA)(1)	52.08 - 15 - 10 V	BFX38 BFX40	V(BR)CEO	55 75		Vo
Collector-Base Breakdown Voltage (I _C = 10 μ A)	S8V eV	BFX38 BFX40	V(BR)CBO	55 75		V
Emitter-Base Breakdown Voltage (I _E = 10 μA)	-10.6 V -20 V +5.2 V	no! dor	V(BR)EBO	5.0	2.0	V
Collector Cutoff Current (VCB = 40 V) (VCB = 50 V) (VCB = 40 V, TA = 125°C) (VCB = 40 V, TA = 125°C)		BFX38 BFX40 BFX38 BFX40	СВО	AV3 #01331.	50 50 50 50	nA μA
ON CHARACTERISTICS					7.71	
Collector-Emitter Saturation Voltage ($I_C = 150$ mA, $I_B = 15$ mA)(1) ($I_C = 500$ mA, $I_B = 50$ mA)(1)			VCE(sat)	=	0.15 0.5	٧
DC Current Gain (I _C = 100 μ A, V _{CE} = 5.0 V)(1) (I _C = 100 mA, V _{CE} = 5.0 V)(1) (I _C = 500 mA, V _{CE} = 5.0 V)(1) (I _C = 1.0 A, V _{CE} = 5.0 V)(1)		BFX38/40 BFX38/40 BFX38/40 BFX38 BFX40	hFE	60 85 60 30 25		
Emitter-Base Saturation Voltage (I _C = 150 mA, I _B = 15 mA)(1) (I _C = 500 mA, I _B = 50 mA)(1)			VBE(sat)	=	0.9 1.1	V
DC Current Gain (I _C = 100 mA, V _{CE} = 5.0 V, T _A =	125°C)(1)	BFX38/40	hFE	30	-	-

(1) Pulsed: Pulse Duration = 300 μ s, Duty Cycle = 1.0%.

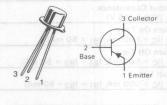
BFX38, BFX40

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

			Characteristic	MAN THE REST		Sym	bol Mir	n Max	Unit		
SMALLS	SIGNAL CHA	ARACTERIS	TICS					RATINGS	NUMBEAN		
	Gain — Band O mA, VCE	= 10 V, f = 1	00 MHz)	Unit	SulsV	lodary8 fg	100	Region A	MHz		
Output C (VCB =	apacitailo	T) 81-0T		Vdc	30	OROV Co	b	20	pF		
	pacitance	Alb		C _{ib} 120					pF		
Turn On Turn On 5	Time 00 mA, I _{B1}	= 50 mA)		Watt DW/M	0.36	og tor	A = 58 C	100	ive() nso		
Turn Off (IC = 5	Time 00 mA, I _{B1}	= I _{B2} = 50	mA)	ansW	1.2 0.688	on tof	f 385 = 5	350	ns _o		
Fall Time	00 mA, I _{B1}	= I _{B2} = 50	mA)	On/Mytes	88.8 (600 + 6+38-	t(- Company	50	a aransi		
	TRANSIS		LIMS								
	xsW.										

MAXIMUM RATINGS Rating Symbol Value Unit 30 Vdc Collector-Emitter Voltage VCEO 30 Collector-Base Voltage **VCBO** 5.0 VEBO Emitter-Base Voltage Collector Current — Continuous 0.1 IC

Vdc Vdc Amp Total Device Dissipation (a TA = 25°C PD 0.36 Watt mW/°C Derate above 25°C 2.06 Total Device Dissipation (a $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ 1.2 Watt PD 0.686 mW/°C 6.86 Derate above 25°C TJ, Tstg °C -65 to +200Operating and Storage Junction



CASE 22-03, STYLE 1

TO-18 (TO-206AA)

THERMAL CHARACTERISTICS

Temperature Range

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	146	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	486	°C/W

SWITCHING TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

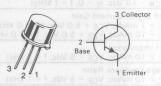
Refer to 2N869A for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (IC = 10 mA)(1)	V(BR)CEO	30		V
Collector-Base Breakdown Voltage (IC = 10 µA)	V(BR)CBO	30		V
Emitter-Base Breakdown Voltage (I _E = 10 μA)	V(BR)EBO	5		V
Collector Cutoff Current (VCE = 20 V) (VCE = 20 V, TA = 125°C)	ICES		15 15	nA μA
ON CHARACTERISTICS				
DC Current Gain $ \begin{aligned} &(IC = 10 \; \mu\text{A, V}_{CE} = 1 \; \text{V}) \\ &(IC = 100 \; \mu\text{A, V}_{CE} = 1 \; \text{V}) \\ &(IC = 100 \; \mu\text{A, V}_{CE} = 1 \; \text{V}) \\ &(IC = 50 \; \text{mA, V}_{CE} = 1 \; \text{V}) \\ &(IC = 10 \; \text{mA, V}_{CE} = 1 \; \text{V}, T_{A} = -55^{\circ}\text{C}) \end{aligned} $	hFE	40 70 90 20 30		
Collector-Emitter Saturation Voltage (IC = 1 mA, IB = 0.1 mA) (IC = 10 mA, IB = 1 mA) (IC = 50 mA, IB = 5 mA) (1)	VCE(sat)		0.13 0.14 0.3	V
Emitter-Base Saturation Voltage (IC = 1 mA, IB = 0.1 mA) (IC = 10 mA, IB = 1 mA) (IC = 50 mA, IB = 5 mA)(1)	VBE(sat)		0.75 0.9 1.1	V
SMALL SIGNAL CHARACTERISTICS				
Current Gain — Bandwidth Product (I _C = 10 mA, V _{CE} = 20 V, f = 100 MHz)	fT	400		MHz
Output Capacitance (VCB = 10 V)	C _{ob}		3.5	pF
Input Capacitance (VEB = 0.5 V)	Cib		5.5	pF
Noise Figure (IC = 1 mA, VCE = 20 V, f = 100 MHz)	NF		6	dB
Turn On Time (I _C = 50 mA, I _{B1} = 5 mA)	ton		50	ns
Turn Off Time (IC = 50 mA, I _{B1} = I _{B2} = 5 mA)	toff		160	ns
Collector-Base Time Constant (I _C = 10 mA, V _{CE} = 20 V, f = 80 MHz)	rb'Cc		40	ps

(1) Pulsed: Pulse Duration = 300 μ s, Duty Cycle = 1%.

BEXES LADIATORIES

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	60	Vdc
Collector-Base Voltage	VCBO	100	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current - Continuous	IC	1.0	Amp
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.8 4.57	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	35	°C/W
Thermal Resistance, Junction to Ambient	RHJA	220	°C/W

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, VBE = 0)	V(BR)CEO	60		Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IB = 0)	V(BR)CBO	100		Vdc
Collector Cutoff Current (VCB = 80 Vdc, IE = 0) . (VCB = 80 Vdc, IE = 0, T _j = 100°C) (VCB = 100 Vdc, IE = 0) (VCB = 100 Vdc, IE = 0, T _j = 100°C)	ICBO		50 2.5 500 2.5	nAdc μAdc nAdc μAdc
Emitter Cutoff Current $(VEB = 5 \text{ Vdc, } I_C = 0)$ $(VEB = 5 \text{ Vdc, } I_C = 0, T_j = 100 ^{\circ}\text{C})$ $(VEB = 6 \text{ Vdc, } I_C = 0)$	IEBO		50 2.5 500	nAdc μAdc nAdc
ON CHARACTERISTICS				
DC Current Gain (IC = 10 mAdc, V_{CE} = 10 Vdc) (IC = 150 mAdc, V_{CE} = 10 Vdc) (IC = 500 mAdc, V_{CE} = 10 Vdc) (IC = 1.0 Adc, V_{CE} = 10 Vdc)	hFE	50 70 30 15		
Collector-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 1.0 mAdc) (IC = 150 mAdc, I _B = 15 mAdc) (IC = 500 mAdc, I _B = 50 mAdc) (IC = 500 ddc, I _B = 100 mAdc)	VCE(sat)		0.15 0.35 1.00 1.60	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)	VBE(sat)		1.2 1.3 1.5 2.0	Vdc

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Max	Unit
SMALL SIGNAL CHARACTERISTICS						
Current Gain Bandwidth Product (IC = 50 mAdc, VCE = 10 Vdc, f = 35 MHz)			fT	50		MHz
Collector Capacitance (VCB = 10 Vdc, I _E = 0, f = 1 MHz)	niedt.	Makey	Cobo	9	12	UMPEAN
Small Signal Current Gain (IC = 1 mAdc, VCF = 5.0 Vdc, f = 1.0 kHz)	250	09	hfe	20	esti av rettin	3 retaille
(IC = 10 mAdc, VCE = 5.0 Vdc, f = 1.0 kHz)			VcBo	25	apallaV see	8 reisellet
Input Impedance	abV	0.8	08 hie		spatioV s	GATΩ
(IC = 10 mAdc, VCE = 5 Vdc, f = 1 kHz)	amA	0.1	nt it	20 Supural	750	O salamini
Voltage Feedback Ratio (IC = 10 mAdc, VCE = 5 Vdc, f = 1 kHz)			hre	@ TA = 25°C	5.0	× 10 4
Output Admittance (IC = 10 mAdc, VCE = 5 Vdc, f = 1 kHz)	jo.	- 65 to +200	_{gla1} hoe	noitánu	80	μmhos

VCE(sat)	

Rating Or	Symbol	BFY 50	BFY 51	BFY 52	Unit
Collector-Emitter Voltage	VCEO	35	30	20	Vdc
Collector-Base Voltage	Vсво	80	60	40	Vdc
Emitter-Base Voltage	VEBO		6		Vdc
Collector Current - Continuous	IC.		1		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.8 4.6			Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5 28.6			Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	16.5	°C/W
Thermal Resistance, Junction to Ambient	RHJA	89.5	°C/W

BFY50 BFY51 BFY52

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3019 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					Trans II
Collector-Emitter Breakdown Voltage (IC = 10 mA)	BFY50 BFY51 BFY52	V(BR)CEO	35 30 20		V
Collector-Base Breakdown Voltage (IC = 10 μ A)	BFY50 BFY51 BFY52	V(BR)CBO	80 60 40		V
Emitter-Base Breakdown Voltage (IE = 10 μ A)		V(BR)EBO	6		V
Collector Cutoff Current (VCB = 60 V) (VCB = 40 V) (VCB = 30 V)	BFY50 BFY51 BFY52	ICBO		50	nA
Collector Cutoff Current (VCB = 60 V, Tj = 100°C) (VCB = 40 V, Tj = 100°C) (VCB = 30 V, Tj = 100°C)	BFY50 BFY51 BFY52	ICBO		2.5	μΑ
Emitter Cutoff Current (VEB = 5 V) (VEB = 5 V, T _I = 100°C)		IEBO		50 2.8	nΑ μΑ
ON CHARACTERISTICS					
DC Current Gain (IC = 10 mA, VCE = 6 V) (IC = 150 mA, VCF = 6 V)	BFY50 BFY51-52 BFY50	hFE	20 30 30		
(IC = 1 A, VCF = 6 V)	BFY51 BFY52		40 60		
Collector-Emitter Saturation Voltage (IC = 150 mA, IB = 15 mA(1)	BFY50 BFY51-52	VCE(sat)		0.2 0.35	٧
$(I_C = 1 A, I_B = 100 mA(1)$	BFY50 BFY51-52			1 1.6	
Emitter-Base Saturation Voltage $(IC = 1 A, IB = 100 \text{ mA}(1))$		VBE(sat)		2	V

(1) Pulsed: Pulse Duration = $300 \mu s$, Duty Cycle = 1%.

Charac	cteristic			Symbol	Min	Max	Unit
SMALL SIGNAL CHARACTERISTICS							
Small Signal Current Gain (I _C = 1 mA, V _{CE} = 6 V, f = 1 kHz)	BFY50 BFY51-52	BPY BFY BFY 50 51 52	Symbol	hfe	10 30	TeA	MARI
Output Capacitance (V _{CB} = 12 V, f = 500 kHz)	Vdc	35 30 20 80 80 40	OBOV OBOV	Cob		12	10 pF
Current Gain Bandwidth Product (I _C = 50 mA, V _{CE} = 6 V, f = 20 MHz)	BFY50 BFY51-52	8	Veso	fT	60	epidlov sa = Instru	
	TREVE OF WAYN'C	8.0	- GP	0.87	ATTOMO	e Dissent Jes avoc	

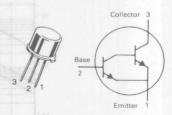
Rating	Symbol	BSS 50	BSS 51	BSS 52	Unit
Collector-Emitter Voltage	VCEO	45	60	80	Vdc
Collector-Emitter Voltage	VCER	45	60	80	Vdc
Collector-Base Voltage	Vсво	60	80	100	Vdc
Emitter-Base Voltage	VEBO	10	5.0	Vdc	
Collector Current - Continuous	Ic /		1.0		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1	0.8 5.3		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	5 28.6		Watt mW/°C	
Operating and Storage Junction	TJ, Tstg	-65	-65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	RHJC	35	°C/W	
Thermal Resistance, Junction to Ambient	RHJA	220	°C/W	

BSS50 BSS51 BSS52

CASE 79-02, STYLE 1 TO-39 (TO-205AD)

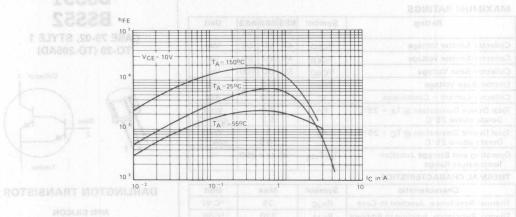


DARLINGTON TRANSISTOR

NPN SILICON

Characteris	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS						
Collector-Cutoff Current (VCB = 45 V, IE = 0) (VCB = 60 V, IE = 0) (VCB = 80 V, IE = 0)	BSS50 BSS51 BSS52	СВО			50 50 50	nA
Emitter-Cutoff Current (VEB = 4 V, IC = 0)		IEBO			50	nA
Collector-Emitter Breakdown Voltage ($I_C = 10 \text{ mA}, I_B = 0$)	BSS50 BSS51 BSS52	V(BR)CEO	45 60 80			V
Emitter-Base Breakdown Voltage (I _B = 100 μA, I _C = 0)		V(BR)EBO	5			V
ON CHARACTERISTICS						
DC Current Gain(1) (I _C = 150 mA, V _{CE} = 10 V) (I _C = 500 mA, V _{CE} = 10 V)		hFE	1500 2000			
Base-Emitter Voltage(1) (IC = 150 mA, VCE = 10 V) (IC = 500 mA, VCE = 10 V)		VBE(on)	1.4 1.5		1.55 1.65	V
Saturation Voltage (1) (IC = 500 mA, IB = 0.5 mA) (IC = 500 mA, IB = 0.5 mA) (IC = 1 A, IB = 1 mA) (IC = 1 A, IB = 1 mA) (IC = 1 A, IB = 4 mA) (IC = 1 A, IB = 4 mA)	BSS51 BSS51 BSS50-52 BSS50-52	VCE(sat) VBE(sat) VCE(sat) VBE(sat) VCE(sat) VBE(sat)			1.3 1.9 1.6 2.2 1.6 2.2	V
DYNAMIC CHARACTERISTICS						
Current Gain Bandwidth Product (I _C = 500 mA, V _{CE} = 5, f = 20 MHz)		fŢ		70		MHz
Output Capacitance (VCB = 10 V, IE = 0, f = 1 MHz)		Cob		11	25	pF
Turn On Time (IC = 500 mA, $IB_1 = -IB_2$ Turn Off Time (IC = 500 mA, $IB_1 = -IB_2$		ton toff		400 1500		ns

⁽¹⁾ Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2%, unless otherwise specified.



MAXIMUM RATINGS					
Rating	Symbol	BSS 71	BSS 72	BSS 73	Unit
Collector-Emitter Voltage	VCEO	200	250	300	Vdc
Collector-Base Voltage	VCBO	200	250	300	Vdc
Emitter-Base Voltage	VEBO	6.0			Vdc
Collector Current - Continuous	IC	0.5		Adc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		0.5 2.86		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.5 14.3		Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +200		°C	

3 Collector 2 Base 1 Emitter

CASE 22-03, STYLE 1 TO-18 (TO-206AA)

HIGH VOLTAGE TRANSISTOR

NPN SILICON

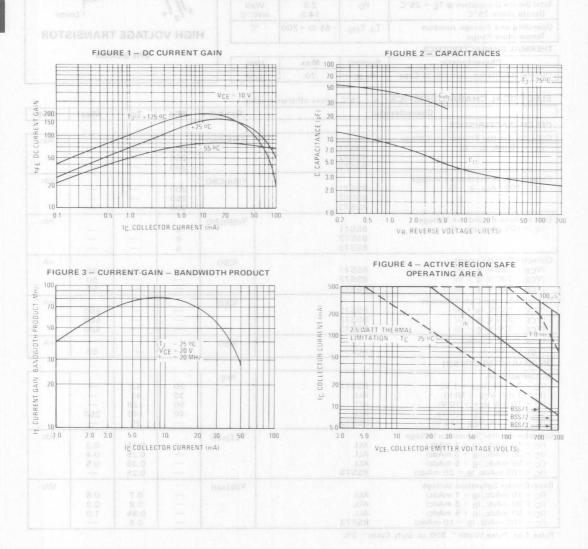
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	01 70	°C/W

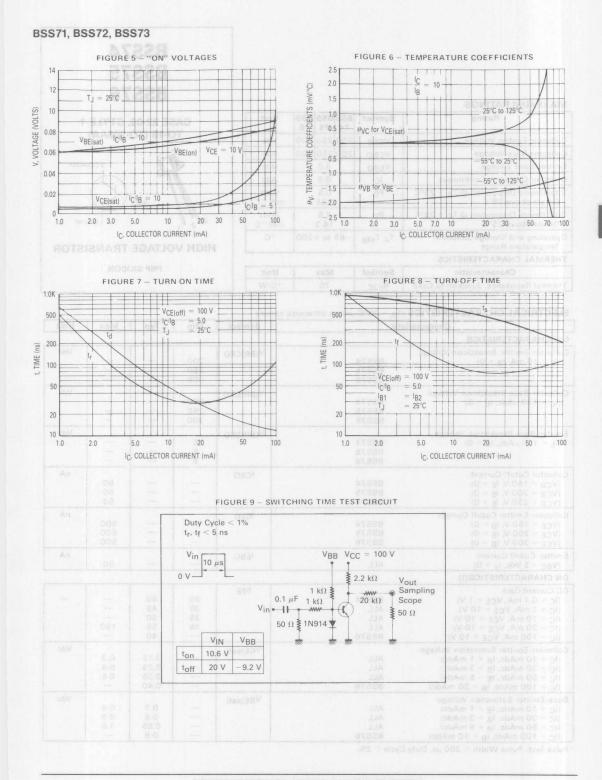
Characteristic	I I I I I		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			50	THE T	1		
Collector-Emitter Breakdown Voltage (IC = 10 mA, I _B = 0)	BSS71 BSS72 BSS73		V(BR)CEO	200 250 300			Vdc
Collector-Base Breakdown Voltage (IC = 100 pAdc, IE = 0)	BSS71 BSS72 BSS73		V(BR)CBO	200 250 300			Vdc
Emitter-Base Breakdown Voltage (IE = 100 µAdc, IC = 0)	BSS71 BSS72 BSS73	101	V(BR)EBO	6 6 6	730101-31		Vdc
Collector Cutoff Current (VCB = 150 V, IE = 0) (VCB = 200 V, IE = 0) (VCB = 250 V, IE = 0)	BSS71 BSS72 BSS73	TOL	IСВО	ONAS - V	RENT GAR	50 50 50	nA HUOPA
Collector-Emitter Cutoff Current (VCE = 150 V, IB = 0) (VCE = 200 V, IB = 0) (VCE = 300 V, IB = 0)	BSS71 BSS72 BSS73		ICEO			500 500 500	nA
Emitter-Cutoff Current (VBE = 5 Vdc, I _C = 0)	ALL		IEBO	100 150 - 110 M		50	nA
ON CHARACTERISTICS (1)							
DC Current Gain (IC = 0.1 mA, VCE = 1 V) (IC = 1 mA, VCE = 10 V) (IC = 10 mA, VCE = 10 V) (IC = 30 mA, VCE = 10 V) (IC = 100 mA, VCE = 10 V)	BSS71 ALL ALL ALL BSS73		hFE	20 30 50 40	40 45 120 140 35	 250	
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1 mAdc) (IC = 30 mAdc, IB = 3 mAdc) (IC = 50 mAdc, IB = 5 mAdc) (IC = 100 mAdc, IB = 20 mAdc)	ALL ALL ALL BSS73	997	VCE(sat)	US DI	0.15 0.25 0.35 0.25	0.3 0.4 0.5	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1 mAdc) (IC = 30 mAdc, IB = 3 mAdc) (IC = 50 mAdc, IB = 5 mAdc) (IC = 100 mAdc, IB = 10 mAdc)	ALL ALL ALL BSS73		VBE(sat)		0.7 0.8 0.85 0.9	0.8 0.9 1.0	Vdc

^{*}Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2%.

Characteristic			Symbol	Min	Тур	Max	Unit
DYNAMIC CHARACTERISTICS							
Current Gain Bandwidth Product (IC = 20 mAdc, VCE = 20 Vdc, f = 20 MHz)		1	ft	50	70	200	MHz
Output Capacitance (IE = 0, VCB = 20 Vdc, f = 1 MHz)			Cob		3.5	-	pF
Input Capacitance (IC = 0, VEB = 0.5 Vdc, f = 1 MHz)	SPA	000 005 0	Cib		45	FOV ASAB-	pF
Turn On Time (I _{B1} = 10 mA, I _C = 50 mAdc, V _{CC} = 100 Vdc)	abV abA	8.0	ton	2	100	Sasa Voltal Current	ns
Turn Off Time (IB2 = 10 mAdc, IC = 50 mAdc, VCC = 100 Vdc)	naW mww.	0.5	toff	= 28%		ice Dissib	







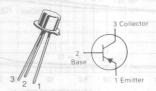
Rating	Symbol	BSS 74	BSS 75	BSS 76	Unit
Collector-Emitter Voltage	VCEO	200	250	300	Vdc
Collector-Base Voltage	Vсво	200	250	300	Vdc
Emitter-Base Voltage	VEBO		5.0	Vdc	
Collector Current - Continuous	Ic		0.5	Adc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		0.5	Watt mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.1	2.5		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65	-65 to +200		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	70	°C/W



CASE 22-03, STYLE 1 TO-18 (TO-206AA)



HIGH VOLTAGE TRANSISTOR

PNP SILICON

Characteris	tic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	10.0					
Collector-Emitter Breakdown Voltage (I _C = 10 mA, I _B = 0)	BSS74 BSS75 BSS76	V(BR)CEO	200 250 300			Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	BSS74 BSS75 BSS76	V(BR)CBO	200 250 300			Vdc
Emitter-Base Breakdown Voltage (IE = 100 µAdc, IC = 0)	BSS74 BSS75 BSS76	V(BR)EBO	6 6 6	0: 0:3 COLLECTOR :	51 = 0.5	Vdc
Collector Cutoff Current (V _C B = 150 V, I _E = 0) (V _C B = 200 V, I _E = 0) (V _C B = 250 V, I _E = 0)	BSS74 BSS75	ICBO		=	50 50 50	nA
Collector-Emitter Cutoff Current ($VCE = 150 \text{ V}, IB = 0$) ($VCE = 200 \text{ V}, IB = 0$) ($VCE = 300 \text{ V}, IB = 0$)	BSS74 BSS75 BSS76	ICEO	0/4 4=0 0 + + + 4 		500 500 500	nA
Emitter-Cutoff Current (VBE = 5 Vdc, I _C = 0)	V 801 = 33V 88V	IEBO	Vin Vin		50	nA
ON CHARACTERISTICS (1)						
DC Current Gain	BSS74	41m ^V	20 30 35 35	40 45 50 55 40	 150	
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1 mAdc) (IC = 30 mAdc, IB = 3 mAdc) (IC = 50 mAdc, IB = 5 mAdc) (IC = 100 mAdc, IB = 20 mAdc)	ALL ALL ALL BSS76	VCE(sat)	01 _40 ² 05 _10 ²	0.15 0.25 0.35 0.40	0.3 0.4 0.5	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1 mAdc) (IC = 30 mAdc, IB = 3 mAdc) (IC = 50 mAdc, IB = 5 mAdc) (IC = 100 mAdc, IB = 10 mAdc)	ALL ALL ALL BSS76	VBE(sat)		0.7 0.8 0.85 0.9	0.8 0.9 1.0	Vdc

^{*} Pulse Test: Pulse Width $\leq 300~\mu s,$ Duty Cycle $\leq 2\%.$

ELECTRICAL CHARACTERISTICS (continued) (TA - 25°C unless otherwise noted.)

Characteristic	-,000:	Symbol	Min	Тур	Max	Unit
DYNAMIC CHARACTERISTICS	2					
Current Gain Bandwidth product (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 20 MHz)	-100d	ft	50	110	200	MHz
Output Capacitance (I _E = 0, V _{CB} = 20 Vdc, f = 1 MHz)		Cob	[3.5		pF
Input Capacitance (I _C = 0, V _{EB} = 0.5 Vdc, f = 1 MHz)	our E	Cib		45		pF
Turn On Time (IB1 = 10 mA, IC = 50 mAdc, VCC = 100 Vdc)	De -	ton	S = 90¥	100		ns
Turn Off Time (IB2 = 10 mAdc, IC = 50 mAdc, VCC = 100 Vdc)	-05	toff		400		ns



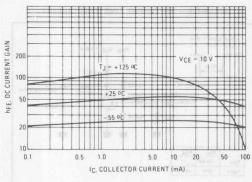


FIGURE 2 - CAPACITANCES

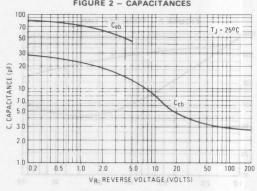


FIGURE 3 - "ON" VOLTAGES

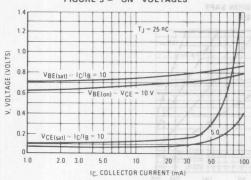
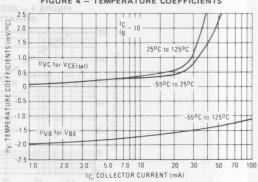
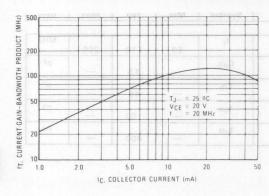


FIGURE 4 - TEMPERATURE COEFFICIENTS







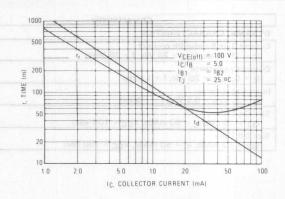
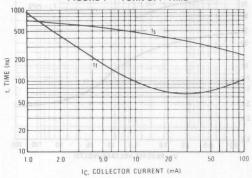
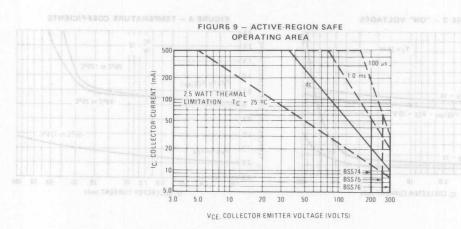


FIGURE 7 - TURN-OFF TIME 1000 500

FIGURE 8 - SWITCHING TIME TEST CIRCUIT Duty Cycle < 10/o t_r, t_f < 5 ns VCC = 100 V 1 K 52 50 Ω 3 -10 6V TON TOFF -20V +9 2V

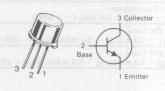
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BSS78

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



HIGH VOLTAGE TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	250	Vdc
Collector-Base Voltage	VCBO	250	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	IC	1.0	Adc
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD Mol	0.8 4.57	Watt mW/°C
Total Device Dissipation (α T _C = 25°C Derate above 25°C	PD	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 10 mA, I _B = 0)	V(BR)CEO	250	-	-	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	V(BR)CBO	250	-		Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	6.0	_		Vdc
Collector Cutoff Current (V _{CB} = 200 V, I _E = 0)	ІСВО		_	50	nA
Collector-Emitter Cutoff Current ($V_{CE} = 200 \text{ V}, I_B = 0$)	ICEO		-	500	nA
Emitter-Base Cutoff Current (V _{BE} = 5.0 Vdc, I _C = 0)	I _{EBO}			50	nA
ON CHARACTERISTICS(1)					
DC Current Gain (IC = 0.1 mA, V _{CE} = 1.0 V) (IC = 1.0 mA, V _{CE} = 10 V) (IC = 10 mA, V _{CE} = 10 V) (IC = 30 mA, V _{CE} = 10 V) (IC = 30 mA, V _{CE} = 10 V) (IC = 100 mA, V _{CE} = 10 V)	hFE	20 30 50 40	40 45 120 140 35	 250 	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 30 mAdc, I _B = 3.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 100 mAdc, I _B = 20 mAdc)	VCE(sat)	Ē	0.15 0.25 0.35 0.25	0.3 0.4 0.5	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 1.0 mAdc) (IC = 30 mAdc, I _B = 3.0 mAdc) (IC = 50 mAdc, I _B = 5.0 mAdc) (IC = 100 mAdc, I _B = 10 mAdc)	VBE(sat)	Ē	0.7 0.8 0.85 0.9	0.8 0.9 1.0	Vdc

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
DYNAMIC CHARACTERISTICS			JUNE BE				
Current Gain Bandwidth Product (IC = 20 mAdc, VCE = 20 Vdc, f = 20 MHz)			ft	50	70	200	MHz
Output Capacitance	HaU	sulsv	Cob			anits H	pF
(IE = 0, V _{CB} = 20 Vdc, f = 1 MHz)		250	Vera -		3.5	estloVism	п3-тогля Го
Input Capacitance (IC = 0, VEB = 0.5 Vdc, f = 1 MHz)	sbV	250	Cib		45	agalloV es	pF
Turn On Time	Diff	0.0	ton			abanua	ns
$(l_{B1} = 10 \text{ mA}, l_{C} = 50 \text{ mAdc}, V_{CC} = 100 \text{ Vdc})$		0.1	10		100	où	i i i i i i i i i i i i i i i i i i i
Turn Off Time (I _{B2} = 10 mAdc, I _C = 50 mAdc, V _{CC} = 100 Vdc)	mW Off Wint	0.8	toff 09	318	400	Orasipution 3 dt. ave	da stareŭ
remma 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	assaw -	5.0	gq	5'6	W TC = 2	Ossipation	otal Devic

V(BR)CBO		

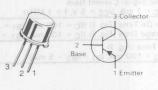
Rating	Symbol	BSV 15	BSV 16	BSV 17	Unit
Collector-Emitter Voltage	VCEO	40	60	80	Vdc
Collector-Emitter Voltage	VCES	40	60	90	Vdc
Collector-Base Voltage	VCBO	40	60	90	Vdc
Emitter-Base Voltage	VERO		5		Vdc
Collector Current - Continuous	IC	1		Adc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1.25 7.15			Watt mW/°C
Total Device Dissipation @ TC = 25°C Derate above 25°C	PD	7 40		Watt mW/°C	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit	
Thermal Resistance, Junction to Case	R+JC	20	°C/W	
Thermal Resistance, Junction to Ambient	RHJA	140	°C/W	

BSV15,10,16 BSV16,10,16 BSV17,10,16

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AMPLIFIER TRANSISTOR

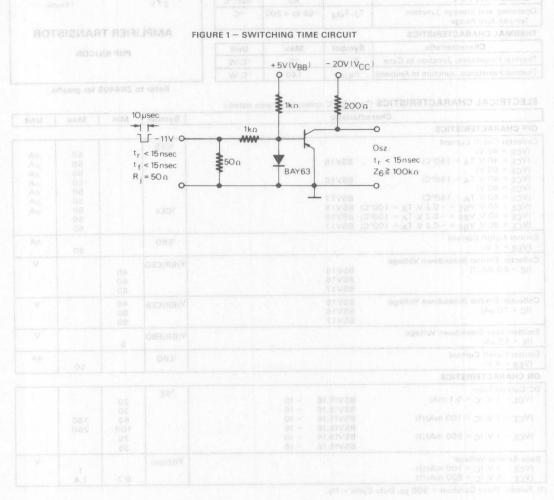
PNP SILICON

Refer to 2N4405 for graphs.

Chara	acteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector Cutoff Current (VCE = 40 V) (VCE = 40 V, TA = 150°C) (VCE = 60 V, (VCE = 60 V, TA = 150°C) (VCE = 80 V) (VCE = 80 V, TA = 150°C) (VCE = 80 V, TA = 150°C) (VCE = 40 V, VBE = -0.2 V, TA = 100° (VCE = 80 V, VBE = -0.2 V, TA = 100° (VCE = 80 V, VBE = -0.2 V, TA = 100°	C) BSV16	ICES		50 50 50 50 50 50 50 50	nA μA nA μA nA μA
Emitter Cutoff Current (VEB = 4 V)		IEBO		50	nA
Collector-Emitter Breakdown Voltage (IC = 50 mA(1)	BSV15 BSV16 BSV17	V(BR)CEO	40 60 80		V
Collector-Emitter Breakdown Voltage (IC = 10 μ A)	BSV15 BSV16 BSV17	V(BR)CES	40 60 90		٧
Emitter-Base Breakdown Voltage (I _E = 10 μA)		V(BR)EBO	5		V
Emitter Cutoff Current (VEB = 4 V)		IEBO		50	nA
ON CHARACTERISTICS					
DC Current Gain (VCE = 1 V, IC = 0.1 mA) (VCE = 1 V, IC = 100 mA) (1) (VCE = 1 V, IC = 500 mA) (1)	BSV15,16 - 10 BSV15,16 - 16 BSV15,16 - 10 BSV15,16 - 16 BSV15,16 - 10 BSV15,16 - 10	hFE	20 30 63 100 25 35	160 250	
Base-Emitter Voltage (VCE = 1 V, IC = 100 mA)(1) (VCF = 1 V, IC = 500 mA)(1)		VBE(on)	0.7	1 1.4	V

⁽¹⁾ Pulsed: Pulse Duration = 300 μ s, Duty Cycle = 1%.

g11412040	,,,,,,,,			Symbol	Min	Max	Unit
SMALL SIGNAL CHARACTERISTICS			T anits8				
Current Gain Bandwidth Product		15 16 17		fT			MHz
$(I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 20 \text{ MHz})$	100	09 00 00	anni/		50	W. sattems	antsalla.
Output Capacitance (VCB = 10 V, IE = 0, f = 1 MHz)				Cob	egati	25	pF
Small Signal Current Gain (IC = 1 mA, VCE = 5 V, f = 1 MHz)	Vide	8 00 08	VERO	hfe	20	parov prac	angerer niner-B
Turn On Time (Fig. 1) (IC = 100 mA, IB1 = IB3 Storage Time (Fig. 1) (IC = 100 mA, IB1 = IB		1 26	1c	t _{on}	Continuous con (6 Ta	500 500	ns
Fall Time (Fig. 1) (IC = 100 mA, IB1 = IB2 = 5 mA)	3-1Wm	7.15	28	tf	5 6 00	150	ns
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	20000000	0.5				Sels avec	##I519Q



Rating	Symbol	BSW67A	BSW68A	Unit
Collector-Emitter Voltage	VCEO	120	150	Vdc
Collector-Base Voltage	Vсво	120	150	Vdc
Emitter-Base Voltage	VEBO	sev 6	.0 O.	Vdc
Collector Current — Continuous	IC	sev 2	.0	Amp
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	STRUCTURE LINE	.8 000 57 _{Ann}	Watt mW/°C
Total Device Dissipation (a $T_C = 25^{\circ}C$ Derate above $25^{\circ}C$	PD	7	.0 80.8	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	+ 200	°C

3 Collector 2 Base 1 Emitter

CASE 79-02, STYLE 1 TO-39 (TO-205AD)

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	220	°C/W

TRANSISTOR

NPN SILICON

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		Merch announce seems	ALL ALLES	GIRA LUA	Service Disc	MATERIAL STATES
Collector-Emitter Breakdown Vo (I _C = 10 mAdc, I _B = 0)	ltage loanssalV	BSW67A BSW68A	V(BR)CEO	120	ACTERISTIC	
Collector-Base Breakdown Volta ($I_C = 100 \mu Adc$)		BSW67A BSW68A	V(BR)CBO	120 150	mAdd, 19 = 1 mAdd, 88E se Br <u>e</u> ekdow	Vdc
Collector-Base Cutoff Current (V _{CB} = 60 V, I _E = 0) (V _{CB} = 75 V, I _E = 0) (V _{CB} = 60 V, I _E = 0, T _J = 15 (V _{CB} = 75 V, I _E = 0, T _J = 15		BSW67A BSW68A BSW67A BSW68A	СВО	- (c	100 100 100 100	nAdc μAdc
Emitter-Base Cutoff Current $(V_{EB} = 3.0 \text{ V}, I_{C} = 0)$ $(V_{EB} = 6.0 \text{ V}, I_{C} = 0)$			IEBO	10 :	100 100	nAdc μAdc
ON CHARACTERISTICS	xaal ka				34.5	
DC Current Gain (I _C = 10 mA, V _{CE} = 5.0 V) (I _C = 100 mA, V _{CE} = 5.0 V) (I _C = 500 mA, V _{CE} = 5.0 V) (I _C = 1.0 A, V _{CE} = 5.0 V)			D. 99	30 40 30 15	CTERISTIC CART TACTVOE TACTVOE O MAde: VOE	00 Current 10 = 10 10 = 10
Collector-Emitter Saturation Vol- (I _C = 100 mA, I _B = 10 mA) (I _C = 500 mA, I _B = 50 mA) (I _C = 1.0 A, I _B = 150 mA)	tage Jagv		VCE(sat)	e 20 we, T ₁ stion Voltag	0.15 Au	Vdc
Emitter-Base Saturation Voltage (I _C = 100 mA, I _B = 10 mA) (I _C = 500 mA, I _B = 50 mA) (I _C = 1.0 A, I _B = 150 mA)	UBS138V		VBE(sat)	10 mAde)	0.9 1.1 1.4	Vdc
SMALL-SIGNAL CHARACTERIST	rics			(bb/em 07	E Bl. obam I	PRI E DIL
Current-Gain — Bandwidth Prod (I _C = 100 mA, V _{CE} = 20 V, f			f _T	50	-	MHz
Output Capacitance $(V_{CB} = 10 \text{ V, I}_{E} = 0, f = 1.0 \text{ I}$	MHz)		C _{obo}	_	20	pF
Input Capacitance (VEB = 0, IC = 0, f = 1.0 MH	z)		C _{ibo}	- 1	300	pF

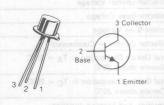
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	15	Vdc
Collector-Emitter Voltage (RBE = 10 Ohms)	VCER	20	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	4.5	Vdc
Collector Current - Continuous	IC .	W 500 84	mAmp
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	360	mWatt mW/°C
Total Device Dissipation @ $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above $25^{\circ}C$	PD	1.2 6.85	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	146	°C/W

BSX20

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



TRANSISTOR

NPN SILICON

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	OBD(BB) V	RSWATA	ugur	(C)	all objects	0 / = 5h
Collector-Emitter Breakdown Volta (IC = 10 mAdc, IB = 0) (IC = 10 mAdc, RBE = 10 Ω)	ge ово(яв)V	AsaWas	V(BR)CEO V(BR)CER	15 20	lose Break	Vdc rotsello2
Emitter-Base Breakdown Voltage (IE = 10 µAdc, IC = 0)		ABWSB	V(BR)EBO	4.5		Vdc
Collector Cutoff Current (VCB = 20 Vdc, IE = 0) (VCB = 20 Vdc, IE = 0, T _j = 150°	080°C)	AV9W88 A8W88	СВО	(0 (0 (0	400 30	nAdc μAdc
Collector Cutoff Current (VCE = 15 Vdc, VBE = 0, $T_j = 5$! (VCE = 40 Vdc, VBE = 0)	onal	ANWEE	ICES	0, T _{.J} = 181 urrent	0.4 1.0	μAdc
Cutoff Current $(VCE = 15 \text{ Vdc}, VBE = -3 \text{ V}, T_j = -3 \text{ V})$	= 55°C)		ICEX IBEX		0.6 0.6	µAdc
ON CHARACTERISTICS	39/				t Gain	nernia ac
DC Current Gain (IC = 10 mAdc, VCE = 1 Vdc) (IC = 10 mAdc, VCE = 1 Vdc, Tj (IC = 100 mAdc, VCE = 2 Vdc)	= -55°C)		hFE	40 20 10	120	10 - 11 10 - 11 10 - 11
Base-Emitter On Voltage (IC = 30 μAdc, VCE = 20 Vdc, T	= 100°C)		VBE(on)	HoV noties (Am 01	0.35	Vdc
$ \begin{array}{ll} \mbox{Emitter-Collector Saturation Volta;} \\ \mbox{(IC} = 10 \mbox{ mAdc, IB} = 0.3 \mbox{ mAdc)} \\ \mbox{(IC} = 10 \mbox{ mAdc, IB} = 1 \mbox{ mAdc)} \\ \mbox{(IC} = 100 \mbox{ mAdc, IB} = 10 \mbox{ mAdc)} \\ \end{array} $	(USA) REV		VCE(sat)	tAm 08 tAm 08 epstloV no (Am 01	0.3 0.25 0.60	Vdc
Emitter-Base Saturation Voltage (IC = 10 mAdc, IB = 1 mAdc) (IC = 100 mAdc, IB = 10 mAdc)			VBE(sat)	0.71	0.85 1.50	Vdc

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

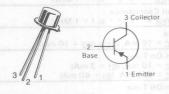
Characteristic		Symbol	Min	Max	Unit			
SMALL SIGNAL CHARACTERISTICS								
Current Gain Bandwidth Product (IC = 10 mA, VCE = 10 V)	tinti	suleV	Symbol	500	enitaR	MHz		
Output Capacitance (VCB = 5 V, IE = 0, f = 1 MHz)	Vele	12	Cobo		gallov reim age 4 V as	pF		
Input Capacitance (VEB = 1 V, IC = o, f = 1 MHz)	Vdc	å nne	Cibo	290000	4.5	pF m		
Time (I _C = 10 mA, I _{B1} = I _{B2} = 10 mA)	- UKAVI	36	ts	@TA - 25°C	13	ns ns		
Turn-On Time (I _C = 10 mA, I _{B1} = 3 mA) (I _C = 100 mA, I _{B1} = 40 mA)	Wall	0.686	ton	8 Tc = 269C Tc = 100FC	12 7	ns ns		
Turn-Off Time (I _C = 10 mA, I _{B1} = 3 mA, I _{B2} = -1.5 mA) (I _C = 100 mA, I _{B1} = 40 mA, I _{B2} = -20 mA)	9.	- 65 to 1200	toff.	unction		n gansang Memorent		

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	12	Vdc
Collector-Base Voltage	VCBO	12	Vdc
Emitter-Base Voltage	VEBO	5	Vdc
Collector Current - Continuous	IC	200	Amp
Total Device Dissipation @ TA = 25°C Derate above 25°C	P _D 2.06	.36	Watt mW/°C
Total Device Dissipation @ $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$ Derate above $25^{\circ}C$	PD	1.2 0.686 6.86	Watt -mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	146	°C/W
Thermal Resistance, Junction to Ambient	RHJA	486	°C/W

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N869A for graphs.

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (IC = 10 mA)(1)	V(BR)CEO	12		V
Collector-Emitter Breakdown Voltage (IC = 10 µA)	V(BR)CES	12		V
Collector-Base Breakdown Voltage (IC = 10 µA)	V(BR)CBO	12		V
Emitter-Base Breakdown Voltage (IE = 100 μA)	V(BR)EBO	4		V
Collector Cutoff Current (VCE = 6 V, VBE = 0) (VCE = 6 V, VBE = 0, TA = 85°C)	ICES		80 5	nA μA
ON CHARACTERISTICS				
Collector-Emitter Saturation Voltage (IC = 10 mA, IB = 1 mA) (IC = 30 mA, IB = 3 mA) (IC = 100 mA, IB = 10 mA)	VCE(sat)		0.15 0.2 0.5	V
Emitter-Base Saturation Voltage (IC = 10 mA, IB = 1 mA) (IC = 30 mA, IB = 3 mA) (IC = 100 mA, IB = 10 mA)	VBE(sat)	0.78 0.85	0.98 1.2 1.7	V
DC Current Gain (IC = 10 mA, VCE = 0.3 V) (1) (IC = 30 mA, VCE = 0.5 V) (1) (IC = 100 mA, VCE = 1 V) (1)	hFE	25 30 20	120	
Collector-Emitter Saturation Voltage (I _C = 30 mA, I _B = 3 mA, T _A = 85°C)	VCE(sat)		0.4	V
SMALL SIGNAL CHARACTERISTICS				
Small Signal Current Gain (IC = 30 mA, VCE = 10 V, f = 100 MHz)	hfe	4		
Output Capacitance (VCB = 5 V)	Cob		6	pF
Input Capacitance (VEB = 0.5 V)	C _{ib}		6	pF
Turn On Time (I _C = 30 mA, I _{B1} = 1.5 mA)	ton		60	ns
Turn Off Time (I _C = 30 mA, I _{B1} = I _{B2} = 1.5 mA)	toff		90	ns

^{*} Pulsed: Pulse Duration = 300 μs, Duty Cycle = 1%.

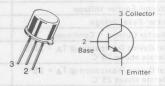
BSX45,-6,-10,-16 BSX46,-6,-10,-16 BSX47,-6,-10,-16

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	65	Vdc
Emitter-Base Voltage	VEBO	HEW 6	Vdc
Collector Current - Continuous	IC .	DEN WEM 1	Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.8	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	3.5	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +200	°C

BSX32

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N3725 for graphs.

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	teristic	Charac			
Collector-Emitter Breakdown Voltage (IC = 10 mA, IB = 0)(1)		V(BR)CEO	40	AUTERIS Cruitos Bri	ALT V
Collector-Base Breakdown Voltage (I _C = 100 μA, I _E = 0)	85X45 85X46	V(BR)CBO	65	gl bown	٧
Emitter-Base Breakdown Voltage ($I_E = 100 \mu A, I_C = 0$)	38530	V(BR)EBO	6	ne rethin 3	notes to
Collector Cutoff Current (VCB = 50 V, IE = 0)	34×29	ІСВО	34 34	4	μА
ON CHARACTERISTICS	BSX47				
DC Current Gain (VCE = 1 V, IC = 10 mA)(1) (VCE = 1 V, IC = 100 mA)(1) (VCE = 1 V, IC = 500 mA)(1) (VCE = 5 V, IC = 1 A)(1)		hFE	30 60 25 20	150	O retrim
$(V_{CE} = 1 \text{ V, } _{C} = 100 \text{ mA}, T_{A} = -55^{\circ}\text{C})(1)$ $(V_{CE} = 1 \text{ V, } _{C} = 500 \text{ mA})(1)$	85X45,46			BO W VBE	
Collector-Emitter Saturation Voltage (IC = 100 mA, IB = 10 mA)(1) (IC = 500 mA, IB = 50 mA)(1) (IC = 1 A, IB = 100 mA)(1)		VCE(sat)	= 0, To = = 0, To = 108	0.25 0.5 0.85	NOE = NOE = NOHAR
Base-Emitter Saturation Voltage (IC = 100 mA, IB = 10 mA)(1) (IC = 500 mA, IB = 50 mA)(1) (IC = 1 A, IB = 100 mA)(1)	Gr 10 Gr 10 Gr 16	VBE(sat)	V 0 1 - 3:	0.9 1.5 2	0 = 31
SMALL SIGNAL CHARACTERISTICS	Gr. 10	1171332	0.0.1	K. The file years	-
Small Signal Current Gain (I _C = 50 mA, V _{CE} = 10 V, f = 100 MHz)	Gr. 18 Gr. 6	hfe	0.13 30	V .abAm 0	10 × 50
Output Capacitance (VCB = 10 V)	31.10	Cob		10	pF
Input Capacitance (VEB = 0.5 V)		Cib	Ege CE = 1.0 V	60	pF
Turn On Time (I _C = 500 mA, I _{B1} = 50 mA)		ton	(abV 0.	60	ns
Turn Off Time (IC = 500 mA, IB1 = IB2 = 50 mA)		toff	(abAm 00)	60	ns

^{*}Pulsed: Pulse Duration = 300 µs, Duty Cycle = 1%.

Rating	Symbol	BSX 45	BSX 46	BSX 47	Unit
Collector-Emitter Voltage	VCEO	40	60	80	Vdc
Collector-Emitter Voltage	VCES	80	100	120	Vdc
Emitter-Base Voltage	VEBO		7		Vdc
Collector Current - Continuous	IC -	34713	mnD 1 8		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	PD 1 5.71			Watt mW/°C
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	ob/v	5 28.6		Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	stg - 65 to +		200	B O °C

THERMAL CHARACTERISTICS

(1) Pulsed: Pulse Duration = 300 μs, Duty Cycle = 1%.

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	29 35 005	oloC/W
Thermal Resistance, Junction to Ambient	RHJA	200	°C/W

BSX45,-6,-10,-16 BSX46,-6,-10,-16 BSX47,-6,-10,-16

> CASE 79-02, STYLE 1 TO-39 (TO-205AD)





AMPLIFIER TRANSISTOR

NPN SILICON

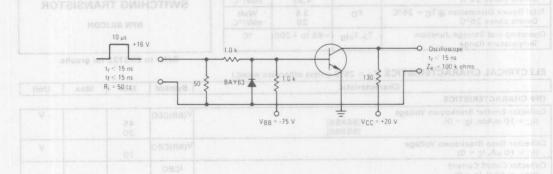
Refer to 2N3019 for graphs.

Charac	teristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS			anath	V nwabalas	en istimi	- attestic
Collector-Emitter Breakdown Voltage(1) (IC = 30 mAdc, IB = 0)	BSX45 BSX46 BSX47		V(BR)CEO	40 60 80	Base Break O pA, IE	Vdc
Collector-Emitter Breakdown Voltage (IC = 100 µAdc, VBE = 0)	BSX45 BSX46 BSX47	100	V(BR)CES	80 100 120	U pA, IC = Sutoff Cun ACTERNST	Vdc
Emitter-Base Breakdown Voltage (IE = 100 μAdc, IC = 0)			V(BR)EBO	11 7 m 0	Gain I	- Vdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)			IEBO	(F)(Am 00 (f)(Am 00	0 10 V	nAdc
Collector Cutoff Current (VCE = 60 V, VBE = 0) (VCF = 80 V, VBF = 0)	BSX45,46 BSX47	(1	CES	AT Am 00	10	nAdc
(VCE = 60 V, VBE = 0, TC = 150°C) (VCE = 80 V, VBE = 0, TC = 150°C)	BSX45,46 BSX47		egafi	TO mAIT	10	μAdc
ON CHARACTERISTICS						
DC Current Gain (IC = 0.1 mAdc, V_{CE} = 1.0 Vdc) (IC = 100 mAdc, V_{CE} = 1.0 Vdc) (1)	Gr. 6 Gr. 10 Gr. 16 Gr. 6 Gr. 10		hFE	10 15 25 40 63	100 160	((c) = 10 ((c) + 50 ((c) = 1)
(I _C = 500 mAdc, V _{CE} = 1.0 Vdc) (1)	Gr. 16 Gr. 6 Gr. 10 Gr. 16		(HM 001	100 15 25 35	250 (a) 20V Am	08 ± 51
Base-Emitter On Voltage (IC = 100 mAdc, VCE = 1.0 Vdc) (IC = 500 mAdc, VCE = 1.0 Vdc) (IC = 1 A, VCE = 1.0 Vdc)			VBE(on)	0.75	1.5	Vdc
Collector-Emitter Saturation Voltage (IC = 1 Adc, IB = 100 mAdc)			VEC(sat)	(Am Ge =	1 am	Vdc
SMALL SIGNAL CHARACTERISTICS			(Am 0	6 - 881 -	tel Am 0	04 - 31
Transition Frequency (IC = 50 mAdc, VCE = 10 Vdc, f = 20 MI	Hz)	- 10° k = 34	fT	50	Melde asi	MHz
Emitter-Base Capacitance (VBF = 0.5 V, f = 1 MHz)			Cib		80	pF

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
Collector-Base Capacitance (VCB = 10 V, f = 1 MHz)	BSX45 BSX46 BSX47	Cob	25 20 20 15		pF MXAA
Turn On Time	See Figure 1 (IC = 100 mAdc)	ton	gnis	200	ns
Turn Off Time	$I_{B1} = -I_{B2} = 5 \text{ mAdc}$	toff	posti	850	otbello

FIGURE 1 - SWITCHING TIME TEST CIRCUIT



Collector-Emitter Voltage

Collector-Emitter Voltage

Collector Current - Continuous

Operating and Storage Junction

Total Device Dissipation @ TA = 25°C

Total Device Dissipation @ T_C = 25°C

Collector-Base Voltage

Emitter-Base Voltage

Derate above 25°C

Derate above 25°C

Temperature Range

Rating

BSX60

CASE 79-02, STYLE 1 TO-39 (TO-205AD)





SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N3725 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.

BSX

59

45

60

70

Symbol

VCEO

VCES

VCBO

VEBO

IC

PD

PD

TJ, Tstg

BSX

60

30

60

70

5.0

0.8

4.57

3.5

20

65 to +200

Unit

Vdc

Vdc

Vdc

Vdc

Adc

mW/°C

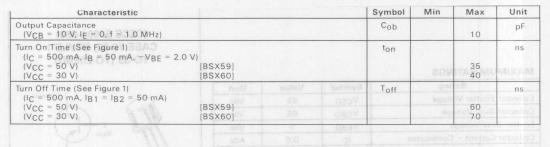
Watt

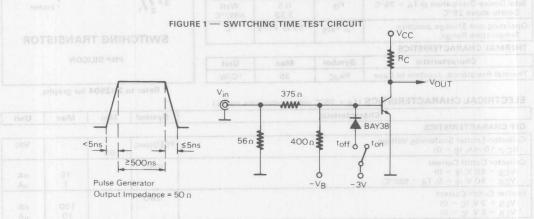
mW/°C

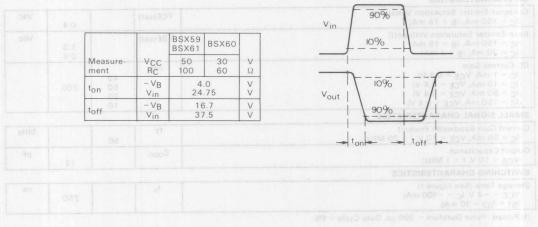
°C

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)				
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IB = 0) [BSX59] [BSX60]	V(BR)CEO	45 30		. V
Collector-Base Breakdown Voltage (IC = 10 μ A, IE = 0)	V(BR)CBO	70		V
Collector Cutoff Current $(V_{CB} = 40 \text{ V, } I_{E} = 0)$ $(V_{CB} = 40 \text{ V, } I_{E} = 0, \text{ T}_{J} = 150^{\circ}\text{C})$	ІСВО		500 300	nA μA
Emitter Cutoff Current (VEB = 4.0 V, IC = 0) (VEB = 4.0 V, IE = 0, TJ = 150°C)	IEBO		300 50	nΑ μΑ
Collector Cutoff Current (VCE = 40 V, -VBE = 4.0 V) (VCE = 40 V, -VBE = 4.0 V, T _J = 150°C)	ICEX		500 300	nA μA
Emitter Cutoff Current (VCE = 40 V, -VBE = 4.0 V) (VCE = 40 V, -VBE = 4.0 V, TJ = 150°C)	IBEX		500 300	nA μA
ON CHARACTERISTICS			EE	
Collector-Emitter Saturation Voltage (IC = 150 mA, IB = 15 mA) (IC = 500 mA, IB = 50 mA) (IC = 1.0 A, IB = 100 mA)	VCE(sat)		0.3 0.5 1.0	V
Base-Emitter Saturation Voltage (IC = 150 mA, IB = 15 mA) (IC = 500 mA, IB = 50 mA) [BSX59] (IC = 1.0 A, IB = 100 mA)	VBE(sat)		1.0 1.2 1.3 1.8	V
DC Current Gain	hFE	30 25 30 20 25	90	
SMALL SIGNAL CHARACTERISTICS				
Small Signal Current Gain (IC = 50 mA, VCE = 10 V, f = 100 MHz)	hfe	2.5		
Input Capacitance (-VBE = 0.5 V, I _C = 0, f = 1.0 MHz)	Cib		60	pF

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4			
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(CECC 50004-050) **CASE 79-02, STYLE 1** TO-39 (TO-205AD)





SWITCHING TRANSISTOR

PNP SILICON

Refer to 2N2904 for graphs.

Unit

Vdc

Vdc

Vdc

Adc

Watt

mW/°C

Operating and Storage Junction THERMAL CHARACTERISTICS

Collector Current - Continuous

Total Device Dissipation @ TA = 25°C Derate above 25°C

MAXIMUM RATINGS

Collector-Emitter Voltage

Collector-Base Voltage

Temperature Range

Emitter-Base Voltage

Rating

THEITMAL OHAHAOTEMOTIO			
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	35	°C/W

Symbol

VCEO

Vсво

VEBO

IC

PD

TJ, Tstg

Value

65

65

5

0.6

0.5

3.33

-55 to +175

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		pane.		
Collector-Emitter Sustaining Voltage (IC = 10 mA, IB = 0)	VCEO(sus)	65		Vdc
Collector Cutoff Current (V _{CB} = 50 V, I _E = 0) (V _{CB} = 50 V, I _E = 0, T _A = 100°C)	Ісво	Pulse Gen	75 1	nΑ μΑ
Emitter Cutoff Current (VEB = 3 V, IC = 0) *(VEB = 5 V, IC = 0)	IEBO	nt rugiuC	100 10	nA μA

ON CHARACTERISTICS

Collector-Emitter Saturation Voltage(1) (I _C = 150 mA, I _B = 15 mA)		VCE(sat)		0.4	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 150 mA, I _B = 15 mA) (I _C = 30 mA, I _B = 1 mA)	gaxsa tax	VBE(sat)		1.3 0.9	Vdc
DC Current Gain	u 03 00	hFE	taun		
(I _C = 1 mA, V _{CE} = 0.4 V) (I _C = 10 mA, V _{CE} = 0.4 V) (I _C = 50 mA, V _{CE} = 0.4 V)		8V-	40 50 20	200	
(IC = 150 mA, VCE = 0.4 V)		BV-	10		

SMALL SIGNAL CHARACTERISTICS

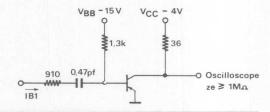
Current Gain Bandwidth Product (I _C = 50 mA, V _{CE} = 10 V, f = 20 MHz)	fT	50		MHz
Output Capacitance (VCB = 10 V, f = 1 MHz)	Cobo		12	pF

SWITCHING CHARACTERISTICS

Storage Time (See Figure 1)	t _S	1111-125	ns
(VCC = -4 V, IC = -100 mA)		250	
$(I_{B1} = I_{B2} = 10 \text{ mA})$		us la la la la la la la la la la la la la	

(1) Pulsed: Pulse Duration = 300 μ s, Duty Cycle = 1%.

FIGURE 1 - SWITCHING TIME TEST CIRCUIT



CV10440

(CECC 50004-087) CASE 22-03, STYLE 1 TO-18 (TO-205AA)

MAXIMUM RATINGS

WAXIIWOW HATIIIGO			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	65	a. Vdc
Collector-Base Voltage	VCBO	55V 65	PA Vdc
Emitter-Base Voltage	VEBO	shy 5	e Vdc
Collector Current - Continuous	Ic		Adc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.6 4.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +175	ot &C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	RHJA	250	°C/W

CV10253 CV12253

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



1 Emitter

3 Collector

AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Hall xsM aiM Characteristic	sitenetia	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			1108	ACTERIS	RAND HID
Collector-Emitter Sustaining Voltage (IC = 10 mA, IB = 0)		VCEO(sus)	65	mA lig = 0	Col V con
Collector Cutoff Current (VCB = 50 V, TE = 0)		Ісво О	int (Emilter	20	= ap /1
Emitter Cutoff Current (I _{EBO} (1) V _{EB} = 3 V, I _C = 0) (I _{EBO} (2) V _{EB} = 5 V, I _C = 0)		IEBO	1 1	20	μΑ
Collector Cutoff Current (VCE = 50 V, TA = 100°C)		ICEO	108 tion Veltag	80	
ON CHARACTERISTICS			(Apr f	= gl ,Am	01 = 04
DC Current Gain $ \begin{array}{lllllllllllllllllllllllllllllllllll$		hFE	40 50 25 35	200	
Base-Emitter Saturation Voltage (1) BBSV (1C = 30 mA, IB = 1 mA) (IC = 150 mA, IB = 15 mA)		VBE(sat)		0.9	
SMALL SIGNAL CHARACTERISTICS		1	dth Produc	wbne3 or	Caven 61
Current Gain Bandwidth Product (IC = 50 mA, VCE = 10 V, f = 35 MHz)		of f	60	mA, Vog	MHz
Storage Time	CV10253		HM 1 = 1	250	= 80VI
$(V_{CC} = 45 \text{ V}, I_{C} = 100 \text{ mA}, I_{B1} = I_{B2} = 10 \text{ mA})$	CV12253	t _s	172	550	THO NS
Output Capacitance (VCB = 10 V, f = 1 MHz)	= (82 = 1 mA)	Cob	gure 1) 15 V. IC =	3 983) am	pF 18

(1) Pulsed: Pulse Duration = 300 μs, Duty Cycle = 1%.

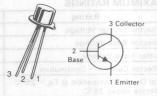


Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	45	Vdc
Collector-Base Voltage	VCBO	aby 45	Vdc
Emitter-Base Voltage	VEBO	aby 5	Vdc
Collector Current - Continuous	Ic	250	mAmp
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.3 2.0	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +175	∘ °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	RHJA	500	°C/W

(CECC 50004-087) CASE 22-03, STYLE 1 TO-18 (TO-206AA)



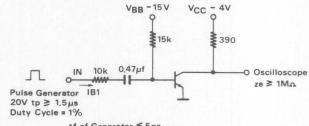
AMPLIFIER TRANSISTOR

NPN SILICON

ELECTRICAL	CHARACTERISTICS	$(T_A =$	25°C unless otherwise noted.)
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Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		2317	PACTERIS	FF CHA
Collector-Emitter Sustaining Voltage (IC = 10 mA, IB = 0)	VCEO(sus)	45	Ermitten Su IIIA, IR C	Vdc
Collector Cutoff Current (Emitter Open) (VCB = 30 V, IB = 0) (VCB = 30 V, IB = 0, TA = 100°C)	ІСВО	žni I	100 15	nΑ μΑ
Emitter Cutoff Current (VEB = 5 V, IC = 0)	IEBO	10 = 01 .V 10 = 01 .V	500	nA
ON CHARACTERISTICS				
Base-Emitter Saturation Voltage (IC = 10 mA, IB = 1 mA) (IC = 50 mA, IB = 2.5 mA)	VBE(sat)	10010)	0.9	Vdc Vdc
DC Current Gain (IC = 10 μ A, VCE = 0.4 V) (IC = 1 mA, VCE = 0.4 V) (IC = 1 mA, VCE = 0.4 V)	0.4 V) 0.4 V) 0.4 V) 0.4 V)		500	(h2/sel) (h2/sel 2 (h2/sel 2 (h2/sel 4
Collector-Emitter Saturation Voltage (IC = 10 mA, IB = 1 mA)	VCE(sat)	son Voltag 1 mA)	0.3	Vdc
SMALL SIGNAL CHARACTERISTICS		(Arm 81)	BLAm 0	81 = 39
Current Gain Bandwidth Product (I _C = 10 mA, V _{CE} = 5 V, f = 35 MHz)	fT ³¹¹³	200	ONAL CH white Bandw	MHz
Output Capacitance (VCB = 5 V, IE = 0, f = 1 MHz)	Cob	1 V 01 =	anv.Am	pF
SWITCHING CHARACTERISTICS	(Am.01 = cgl = 1s	LIAM DUI	-olyan	- bovi
Storage Time (See Figure 1) (VCC = 4 V, VBB = 15 V, IC = 10 mA, IB1 = IB2 = 1 mA)	ts	(setwi	750	ns

FIGURE 1 - SWITCHING TIME TEST CIRCUIT



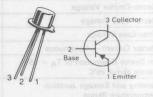
tf of Generator ≤ 5ns

IVIANIIVIOIVI NATIIVOS			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	mAm 5	Vdc
Collector Current - Continuous	Ic	100	mAmp
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	300 2.0	mWatt mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-55 to +175	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	RHJC	200	°C/W
Thermal Resistance, Junction to Ambient	RHJA	500	°C/W

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



AMPLIFIER TRANSISTOR

PNP SILICON

ELECTRICAL	CHARACTERISTICS	$(T_A = 25^{\circ}C$	unless otherwise noted.)
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Characte	eristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Rossings		201215920151	Allen		
Collector-Emitter Sustaining Voltage (IC = 2 mA, IB = 0)	Voleotsust	(0 = gl abAm 0t =	VCEO(sus	40	meiner un Imitter Sust	V
Collector Cutoff Current (Emitter Open)	OBD(88)V	(6 = 31,5bAn	ICBO	gullaV nwg	aso Breekd	
(VCB = 30 V, IE = 0) (VCB = 30 V, IE = 0, TA = 100°C)	OBBIRBIV	$Adc, i_C = 0$	00 = 10	sgaflóV av	100	nA μA
Emitter Cutoff Current (Collector Open) (VFB = 5 V, IC = 0)	080)		IEBO	(0 =	500	nA
ON CHARACTERISTICS	1		(0.00)	- A1 10	3, 100,1 00	B-7*
Collector-Emitter Saturation Voltage (IC = 10 mA, IB = 1 mA)	gan		VCE(sat)	13.19	0.3	V
DC Current Gain (IC = 10 µA, VCE = 5 V) (IC = 2 mA, VCE = 5 V)		(5)	a hFE _{AT}	40 125	400	10 = 30 10 = 30
SMALL SIGNAL CHARACTERISTICS	VCE(sat)	itt mAde lg = 0.15 mAde)	= 30 a0	rstion Volta	Emitter Sittu	-totoelli
Current Gain Bandwidth Product (IC = 10 mA, VCE = 5 V, f = 100 MHz)	(seg)38 ^V]	(16Am 81.0 - 81 mAde)	9.E fT 011	200	ier Saturatio BNAL CHAF	MHz
Small Signal Current Gain (IC = 1 mA, VCE = 10 V, f = 1 kHz)	7	(4)	hfe	100	400	D-inem
Noise Figure (Rg = 2 K Ω , VCE = 5 V, IE = 200 μ A, f = 3	0 Hz to 15 kHz		NF		2	dB
Output Capacitance (VCB = 5 V, f = 1 MHz)	Ciba		Cobo		8	pF

CVIOSIA

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO(sus)	6.0	Vdc
Collector-Base Voltage	VCBO	15	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc Vdc
Collector Current — Continuous	lc	150	- mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.71	mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to + 200	O° 2.€

THERMAL CHARACTERISTICS

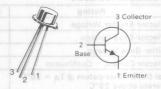
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	R _θ JA(1)	583	°C/W

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

MM1748A

LVL. Z. D.S. For Specifications, See C.

CASE 27-02, STYLE 1 TO-52 (TO-206AC)



SWITCHING TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (T _A = 25°C unless otherwise noted.) Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				mil to the	a more smaller
Collector-Emitter Sustaining Voltage(2) (I _C = 10 mAdc, I _B = 0)	V _{CEO(sus)}	6.0	-	(0 -)1 A	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	15 (1986)	O set tli m8) 1	iemu a I totu	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	4.0	rhinos T	10 = ar v c	Vdc
Collector Cutoff Current (VCB = 5.0 Vdc, I _E = 0) (VCB = 5.0 Vdc, I _E = 0, T _A = 150°C)	ІСВО	(nag((Collector	5.0 5.0	nAdc μAdc
ON CHARACTERISTICS(2)				and and	Lactoria
DC Current Gain (IC = 10 mAdc, VCE = 0.5 Vdc) (IC = 10 mAdc, VCE = 0.5 Vdc, $T_A = -55^{\circ}C$) (IC = 30 mAdc, VCE = 1.0 Vdc)	hFE	30 10 15	55 20 20	90	(lig = 10 (lig = 10 (lig = 10
Collector-Emitter Saturation Voltage (I _C = 3.0 mAdc, I _B = 0.15 mAdc)	VCE(sat)	- 231	0.2	0.3	Vdc
Base-Emitter Saturation Voltage (I _C = 3.0 mAdc, I _B = 0.15 mAdc)	V _{BE} (sat)	0.7	0.78	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 4.0 Vdc, f = 100 MHz)	fτ	800	850	ai C <u>uc</u> rent A. Vog ≓	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 140 kHz)	Cobo	0. µA, F = 36	05 2.0	3.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 140 kHz)	C _{ibo}	-	1.8	2.0	pF
SWITCHING CHARACTERISTICS					
Storage Time ($V_{CC} = 3.0 \text{ Vdc}$, $I_{C} = 5.0 \text{ mAdc}$, $I_{B1} = I_{B2} = 5.0 \text{ mAdc}$)	t _S		4.0	6.0	ns
Turn-On Time $(V_{CC} = 1.0 \text{ Vdc}, V_{BE(off)} = 1.0 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = 2.0 \text{ mAdc}, I_{B2} = 1.0 \text{ mAdc})$	ton		12	15	ns
Turn-Off Time $(V_{CC} = 1.0 \text{ Vdc}, I_C = 10 \text{ mAdc}, I_{B1} = I_{B2} = 1.0 \text{ mAdc})$	toff	_	12	15	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

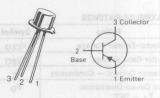
MM3001 thru MM3003 CASE 79-02, STYLE

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	20	Vdc
Collector-Base Voltage	VCBO	25	Vdc
Emitter-Base Voltage	VEBO	4.0	Vdc
Collector Current — Continuous	IC	600	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	400 2.28	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C		1.4 8.0	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	€+ °°C -

MM2005

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N2904 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

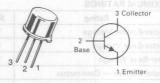
Charac	teristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	Nanragi		(t)no	saloV nyeob	mitter Breek	S-normality
Collector-Emitter Breakdown Voltage(1 (I _C = 10 mAdc, I _B = 0)		V(BR)CEO	20	_ 10	mAda lg =	Vdc
Collector-Base Breakdown Voltage (I _C = 100 µAdc, I _E = 0)	063(88)V	V(BR)CBO	25	ogstloV m	se Breakton	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	083)	V(BR)EBO	4.0	10	utoff Curre	Vdc
Collector Cutoff Current (VCB = 15 Vdc, I _E = 0)		EDGEMM SHOEMICBO	-	(0 =	0.5	μAdc
ON CHARACTERISTICS(1)					OHENSIV	APPRING S
DC Current Gain (IC = 150 mAdc, VCE = 10 Vdc)	344	hFE	100	200	400	namuu or = ot
Collector-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc)	71	VCE(sat)	-1	0.3	1.0	Vdc
Base-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc)	- Cono.	V _{BE} (sat)	SPIRA-OBI E	0.7	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS		PERSONAL CONCRETA	(189)	OUT = 1,0	# BL-3DV US	- SOY
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kHz)		Cobo	s, Dury Cycle	6.0	15	pF
SWITCHING CHARACTERISTICS						0
Turn-On Time (V _{CC} = 30 Vdc, I _C = 150 mAdc, I _{B1}	= 15 mAdc)	ton	-	20	45	μs
Turn-Off Time (V _{CC} = 6.0 Vdc, I _C = 150 mAdc, I _{B1}	= l _{B2} = 15 mAdc)	toff	-	85	100	μs

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

Rating	Symbol	MM3001	MM3002	MM3003	Unit
Collector-Emitter Voltage	VCEO	150	200	250	Vdc
Emitter-Base Voltage	VEBO		5.0	0.5	Vdc
Collector Current — Continuous	Ic	200	50	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		1.0		Watt mW/°C
Total Device Dissipation (a) T _C = 25°C Derate above 25°C	PD	5.0 28.6		Watts mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C	

MM3003

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

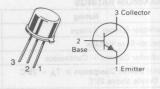
NPN SILICON

	Characte	ristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Min	Symbol		eteristic	Chara		
Collector-Emitter Breakdown Volta	age(1)			V(BR)CEO		contentarios	Vdc
(I _C = 10 mAdc, I _B = 0)		MM3001 MM3002		1	150 200	insr braside Ado, 1g = 0	
and the second	2019	MM3003			150	The state of the s	- Commonths
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)		Osidi(ts)*		V(BR)EBO	5.0	0 = gr.obAu	Vdc
Collector Cutoff Current (VCB = 75 Vdc, IE = 0) (VCB = 100 Vdc, IE = 0)		MM3001 MM3002,	MM3003	ІСВО	_	1.0 5.0	μAdc
ON CHARACTERISTICS		La caracteria				Alayeratery	NA 2 K LOS NO
DC Current Gain (I _C = 10 mAdc, V _{CE} = 10 Vdc)	001	39d		hFE	20	nia	Inemia D
SMALL-SIGNAL CHARACTERISTIC	cs				nootheld on	dissured west	and samether
Current-Gain — Bandwidth Produ (I _C = 10 mAdc, V _{CE} = 20 Vdc,				fT	150	= grabkm	o MHz
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 100	kHz)	MM3001 MM3002,	MM3003	C _{obo}	6 mAde) TERISTICS	7.0 15	can pF _{3l})

MAXIMUM KATINGS	_				
Rating	Symbol	MM3005	MM3006	MM3007	Unit
Collector-Emitter Voltage	VCEO	60	80	100	Vdc
Collector-Base Voltage	VCBO	80	100	120	Vdc
Emitter-Base Voltage	VEBO	BO 5.0		081	Vdc
Collector Current — Continuous	Ic		2.5		Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		1.0 5.71		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	P _D 8.0 45.6		Watts mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C	

MM3006 MM3007

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AUDIO TRANSISTOR

NPN SILICON

C	haracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	OBOURSTV		(1)	own Voltage	biser& rottic	il rotos la
Collector-Emitter Breakdown Voltage (IC = 10 mAdc, IB = 0)	(1) 083(88) ^V	MM3005 MM3006 MM3007	V(BR)CEO	60 80 100	made, ig = gradowie Bischer down according to gradowie gr	
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	0831	MM3005 MM3006 MM3007	V _(BR) CBO	80 100 120	20 Vdc, lg = 26 Current 0 Vdc, lg =	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	344		V(BR)EBO	5.0	nisū.	Vdc
Collector Cutoff Current $(V_{CB} = 60 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 80 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 100 \text{ Vdc}, I_E = 0)$		MM3005 MM3006 MM3007	ІСВО	loby of tov ot sorrainar;	100 100 100	nAdc
Emitter Cutoff Current (VBE = 4.0 Vdc, I _C = 0)			IEBO	(h Pr <u>av</u> luci 20 Vdc, t =	100	nAdc
ON CHARACTERISTICS	pdo0				aonstice	ged Juga
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	odi ⁰	All Types MM3005 MM3006 MM3007	hFE (S)			Caper Supplemental Value Tes
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)			V _{CE(sat)}	-	0.35	Vdc
Base-Emitter On Voltage (I _C = 150 mAdc, V _{CE} = 1.0 Vdc)			V _{BE(on)}	0.60	0.75	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product((I _C = 50 mAdc, V _{CE} = 10 Vdc, f =			fT	50		MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kH	łz)		C _{obo}	-	15	pF

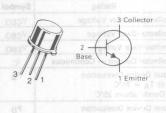
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.



Rating	Symbol	MM3009	Unit
Collector-Emitter Voltage	VCEO	180	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	Ic	400	mAdc
Total Device Dissipation (a T _A = 25°C Derate above 25°C		1.0 5.71	Watt mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	P _D	4.0 22.8	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	+ o°C

MM3009

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



TRANSISTOR

NPN SILICON

C	Characteristic		Symbol	Min	Max	Unit	
OFF CHARACTERISTICS	lodiny8		naracteristic	0			
Collector-Emitter Breakdown Voltage	e(1)		V(BR)CEO	180	eorragato)	Vdc	
$(I_C = 10 \text{ mAdc}, I_B = 0)$	CancagoV		(1)	egatteV nwo	niner Breekel	Collector-Er	
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$			V(BR)EBO	6.0	a e BLobArr	Vdc	
Collector Cutoff Current (VCB = 180 Vdc, I _E = 0)	VIBRICBO	VDGENNA	CEO	egatloV n	0.1 wobiset8 es	μAdc	
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)		MM3008 MM3008	IEBO		0.1	μAdc	
ON CHARACTERISTICS				amedial/	mwahalaan Si a	enst author	
DC Current Gain	OBS(NB) Y		hFE		ينظره او = ا		
(I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 30 mAdc, V _{CE} = 10 Vdc)				30 40 30	toff Current Vdc. Is = 0		
SMALL-SIGNAL CHARACTERISTICS		MMS907		(0	= gl ,obV 00	Vcs - 1	
Current-Gain — Bandwidth Product (IC = 20 mAdc, VCE = 20 Vdc, f	= 20 MHz)		fT	50	off Cu st ents 0 Veta, to = 0	MHz	
Output Capacitance (V _{CB} = 20 Vdc, I _F = 0, f = 1.0 M	(Hz)		C _{obo}	-	80(14.0) 10	ASIA PFISO	
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 N	лНz)	All Types MM2005	C _{ibo}	(bby 0.1 =	30 20 bAm	0.1 pF)1	
1) Pulse Test: Pulse Width = 300 μ s,	Duty Cycle ≤ 2.0%	VOUCHANA CONTRACTOR			mAdo, Vigg mAde, Vigg		

IIIAAIIIIOIII IIAIIIIOO			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	60	Vdc
Emitter-Base Voltage	VEBO	6.0	Vdc
Collector Current — Continuous	IC	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	200	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	500 5.0	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +125	,51,°C _{0.0} =

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	490	°C/W

MM3903 MM3904

CASE 27-02, STYLE 1 TO-52 (TO-206AC)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 m/	Adc, I _B = 0)	V(BR)CEO	40		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E	= 0)	V(BR)CBO	60	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C	= 0)	V(BR)EBO	6.0	_	Vdc
Base Cutoff Current (VCE = 30 Vdc, VEB(off) = 3.0 V	Vdc)	IBEV	-	50	nAdc
Collector Cutoff Current (VCE = 30 Vdc, VEB(off) =	3.0 Vdc)	ICEX	_	50	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc)	MM3903 MM3904	hFE	20 40	=	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3903 MM3904		35 70	Ξ	
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3903 MM3904		50 100	150 300	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3903 MM3904		30 60	Ξ	
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3903 MM3904		10 15	=	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)		VCE(sat)	=	0.2 0.3	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)		VBE(sat)	0.65	0.85 0.95	Vdc

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		В		

SWALE-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(1)			fT		RATINGS	MHz
$(I_C = 10 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz})$		MM3903	Symbol	250	gnitten	
(OABITS OB 23-01)	ABAK	MM3904	Land I	300	married with worth	Company of the last
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)			C _{obo}	_	4.0	pF 288-robolio
Input Capacitance	59.9	0.8	Cibo		8.0	pF
(VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)			Ollo	audus	rimo3 — Ins	1
Small-Signal Current Gain	Witt	200	a h _{fe}	TA = 25°C	ii noitsoleac	ssive C len
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$		MM3903	10	50	200	Derete abo
		MM3904	09	100	400	aniver'l new
SWITCHING CHARACTERISTICS	3°Wm	5.0			es 25°C	ods erate0

	1411413304	AR -	100	400	- univert here.
RISTICS	5.0			1 3°85 av	Derate above
(V _{CC} = 3.0 Vdc, V _{BE(off)} = 0.5 Vdc,		ateT atd	—iditon	ut er35or2 h	or gins log
I _C = 10 mAdc, I _{B1} = 1.0 mAdc)	n de la composição de l	tr		35	ns
$(V_{CC} = 3.0 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = I_{B2} = 1.0 \text{ mAdc})$	MM3903 MM3904	t _S	a <u>o</u> rteir	175 200	ns
S UPUB BUPPU S		admitte.	oil	50	ns
	$(V_{CC} = 3.0 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = 1.0 \text{ mAdc})$ $(V_{CC} = 3.0 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = I_{B2} = 1.0 \text{ mAdc})$	(V _{CC} = 3.0 Vdc, V _{BE} (off) = 0.5 Vdc, I _C = 10 mAdc, I _{B1} = 1.0 mAdc) (V _{CC} = 3.0 Vdc, I _C = 10 mAdc, MM3903 I _{B1} = I _{B2} = 1.0 mAdc)	RISTICS	(VCC = 3.0 Vdc, VBE(off) = 0.5 Vdc, td td - off	RISTICS (V _{CC} = 3.0 Vdc, V _{BE} (off) = 0.5 Vdc, I _C = 10 mAdc, I _{B1} = 1.0 mAdc) (V _{CC} = 3.0 Vdc, I _C = 10 mAdc, MM3903 t _s — 175 MM3904 — 200

(1) Pulse Test: Pulse Width ≤ 30	μ s, Duty Cycle \leq 2.0%.
----------------------------------	----------------------------------

		0 Current Gain 0 C = 0.1 mAdc, Vog = 1.0 Ved) NM3904 NM3904
		(1C = 10 mAde, VCE = 1.0 Vdc) MM3903
		10 × 50 mAdd, Vcg × 1.0 Vdd) • (MM3904 MM3904
	VCE(set)	

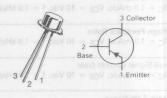
ma ottorio in tottorio			
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	40	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	360 2.06	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	490	°C/W

CASE 27-02, STYLE 1 TO-52 (TO-206AC)

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GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N3250 for graphs.

ELECTRICAL CHARACT			
000	Characteristic	Symbol	Min

Characteristic	ariona sea	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	vite: MM3906	Sm Ct = ol abV C	Noc = 3		His again
Collector-Emitter Breakdown Voltage(1) (I _C = 1.0 mAdc, I _B = 0)	MM3806	V(BR)CEO	40	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)		V(BR)CBO	40	rithiW ealu9 :	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V _{(BR)EBO}	5.0	_	Vdc
Base Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 3.0 Vdc)		IBEV		50	nAdc
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 3.0 Vdc)		ICEV	-	50	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc)	MM3905 MM3906	hFE	30 60	=	-
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3905 MM3906		40 80	=	
$(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3905 MM3906		50 100	150 300	
$(I_C = 50 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3905 MM3906		30 60	=	
$(I_{C} = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MM3905 MM3906		10 15	=	
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)		VCE(sat)	=	0.25 0.4	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 50 \text{ mAdc}$, $I_B = 5.0 \text{ mAdc}$)		V _{BE} (sat)	0.65	0.85 0.95	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(1) (IC = 10 mAdc, VCE = 20 Vdc, f = 100 MHz)	MM3905 MM3906	fT	200 250	=	MHz

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)		C _{obo}		5.0	pF
Input Capacitance (VBE = 0.5 Vdc, $I_C = 0$, $f = 100$ kHz)		C _{ibo}	-	applicant	pF
Input Impedance (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MM3905 MM3906	h _{ie}	0.5 2.0	8.0 12	k ohms
Voltage Feedback Ratio (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MM3905 MM3906	hre	0.1 X 10 ⁻⁴ 1 X 10 ⁻⁴	5 X 10 - 4 10 X 10 - 4	nitter-Basi Slector Cu
Small-Signal Current Gain (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	MM3905 MM3906	h _{fe}	50 100	200 400	sal Device Derate shi
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	MM3905 MM3906	h _{oe}	1.0	40 60	μmhos
Noise Figure (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc, R _S = 1.0 k ohm, f = 10 Hz to 15.7 kHz)	MM3905 MM3906	ALSE IN	alr aldmA_t noit	5.0 4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 3.0 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc},$	td	Service Contracts	35	ns
Rise Time	I _C = 10 mAdc, I _{B1} = 1.0 mAdc)	tr	/ Gyll 1 Cas (21)	35	ns
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mAdc, MM3906	t _S		200 225	ns ARAHO T
Fall Time	I _{B1} = I _{B2} = 1.0 mAdc) MM3905 MM3906	tf	vn V <u>a</u> ltagef	60 75	ns

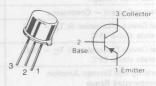
(1) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Rating	Symbol	MM4000	MM4001	MM4002	MM4003	Unit
Collector-Emitter Voltage	VCEO	100	150	200	250	Vdc
Collector-Base Voltage	VCBO	100	150	200	250	Vdc
Emitter-Base Voltage	VEBO	4.0	4.0	4.0	4.0	Vdc
Collector Current — Continuous	lC	100	500	500	500	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.6 3.42	14 3 - 5	1.0 5.71	1.0	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	3.0 17.2	5.0 28.6	5.0 28.6	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}		-65 to	0 +200	25	°C

MM4000 thru MM4003

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

PNP SILICON

Refer to 2N3494 for graphs for MM4000.*

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and about 35°S = AT BOTTOMBATOABARS SACINTOS IN

O Typ Max Unit	haracteris	stic today2	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					ROTERETICS	MAHO THO
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	(1) 08	MM4000	V(BR)CEO	100	mitter Break mAd <u>r. lg</u> =	Vdc
		MM4001 MM4002 MM4003		150 200 250	e gi ,ub A _{lik} ig e	or = of
Collector-Base Breakdown Voltage (IE = 0, IC = 100 μ Adc)	0.6	MM4000 MM4001 MM4002 MM4003	V(BR)CBO	100 150 200 250	JaAdo, 1g = u.off <u>C</u> urrent id Vdo, 1g = off C u rrent	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)			V(BR)EBO	4.0	LO VO <u>C.</u> IB = CTERNSTICS	Vdc
Collector Cutoff Current (VCB = 50 Vdc, IE = 0) (VCB = 75 Vdc, IE = 0) (VCB = 150 Vdc, IE = 0)	40 50	MM4000 MM4001 MM4002, MM4003	Ісво	(ab\\0.1 = (ab\\0.1 = (ab\\0.1 = (ab\\0.1 = (ab\))	1.0	μAdc
ON CHARACTERISTICS		170Ag FEL 1/2		15 mAde)	gi ,anAm i	181 = 50
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 10 Vdc)		Vae(sat)	hFE	20 tolv	nods m ačis s mAdo, ig s	#1m3 -0 m# 8r = 98
Collector-Emitter Saturation Voltage($I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}$)	(1)	MM4000, MM4001 MM4002, MM4003	VCE(sat)	creatence dta Productio	0.6 5.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					BOUNTS IN	Manual Call
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 100 kH	z)	MM4000 MM4001 MM4002, MM4003	Cobo	0, f = 1.0 M	6.0 10 20	e gpF

⁽¹⁾ Pulse Test: PW \leq 300 μ s, Duty Cycle \leq 2.0%. *Refer to 2N3634 for graphs for MM4001. Refer to 2N4930 for graphs for MM4002 and MM4003.

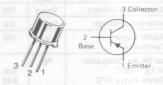
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	U SO 60 ANA SC	Vdc
Collector-Base Voltage	VCBO	60	ous Vdc
Emitter-Base Voltage	VEBO	5.0	oos Vdc
Collector Current — Continuous	Ic a	1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	P _D	1.0 5.71	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	7.0 40	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C °C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	25	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	175	°C/W

(1) R_{BJA} is measured with the device soldered into a typical printed circuit board.

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AMPLIFIER TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (T _A = 25°C unless otherwise noted.)	srito
Characteristic	S

Characte	eristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					35	RACTERISTIC	OFF CHA
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	(2) 33(88)	34000	V(BR)CEO	60 (1)	aNoV a wobi (0)	Emitt er Brea 0 mAdc. lg =	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0)		14001 14002	V(BR)CBO	60		-	Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)	OBD(BS)V	nones	V _{(BR)EBO}	5.0	ensiloV revo	Base Breakde	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)		44001 44002	ІСВО	-	_	100	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IE = 0)	OBarany	A4003	IEBO		epsiloV m	100	nAdc
ON CHARACTERISTICS(2)					- 01)0 JAda, 10	1 = 30
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc) (I _C = 150 mAdc, V _{CE} = 1.0 Vdc)	680	A4000 A4001		40 50	90 150	Curoff Current 50 Vdg. ig = 75 Vdg. ig =	Co <u>lle</u> oter (VCB = (VCB =
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)		ACOUR, MINIAGOS	V _{CE(sat)}	-	0.1	ONTERISMO	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	Bart .		V _{BE(sat)}		0.7 (sbV 01 =	t Gai <u>nl</u> 1)) mAdo, Veg	Vdc
SMALL-SIGNAL CHARACTERISTICS	VCE(sat)			1516	ation Voltage	mitter Satur	Collegion
Current-Gain — Bandwidth Product(2 (I _C = 50 mAdc, V _{CE} = 10 Vdc, f =		AAOO2, MWAGOS	fT	50	250	Mr aparin	MHz
Output Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MH	fz) odo		C _{obo}		10	Dacitance	pF so mano
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MH	⊣z)	44001 44001 44002 MANAGES	C _{ibo}	_ (SPI	100	- 31 (abv 03	pF

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MM4037	mannya	40	
Collector-Base Voltage MM4036 MM4037	VCBO	90 60	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Base Current	IB	500	mAdc
Collector Current — Continuous	IC	1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 5.71	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	7.0 40	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to +200	°C,Am

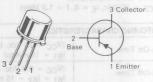
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	25	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	175	°C/W

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

MM4037

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



SWITCHING TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, Ig = 0)	MM4036 MM4037	V(BR)CEO	65 40	-	-	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μ Adc, I _E = 0) (I _C = 10 μ Adc, I _E = 0)	MM4036 MM4037	V(BR)CBO	90 60	=	=	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc$, $I_C = 0$) ($I_E = 1.0 \mu Adc$, $I_C = 0$)	MM4036 MM4037	V(BR)EBO	5.0 5.0	_	=	Vdc
Collector Cutoff Current(1) $ (V_{CE} = 60 \text{ Vdc}, V_{BE\{off\}} = 1.5 \text{ Vdc}) $ $ (V_{CE} = 30 \text{ Vdc}, V_{BE\{off\}} = 1.5 \text{ Vdc}, T_{C} = 150^{\circ}\text{C}) $	MM4036 MM4036	ICEV		_	250 100	nAdo μAdo
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0)	MM4036, MM4037	ICBO	_		250	nAdo
Emitter Cutoff Current ($V_{BE} = 3.0 \text{ Vdc}, I_{C} = 0$) ($V_{BE} = 5.0 \text{ Vdc}, I_{C} = 0$)	MM4036 MM4037	IEBO	_	_	250 1.0	μAdo
ON CHARACTERISTICS(2)						E SECTION
DC Current Gain (I _C = 100 µAdc, V _{CE} = 10 Vdc) (I _C = 150 mAdc, V _{CE} = 2.0 Vdc) (I _C = 150 mAdc, V _{CE} = 10 Vdc) (I _C = 500 mAdc, V _{CE} = 10 Vdc) (I _C = 500 mAdc, V _{CE} = 10 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 150 mAdc, V _{CE} = 10 Vdc)	MM4036 MM4036 MM4036 MM4036 MM4037 MM4037	hFE	20 20 40 20 15 50	50 60 90 40 50 75	200 140 — — 250	_
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	MM4036 MM4037	VCE(sat)	-	0.3 0.3	0.65 1.4	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)		V _{BE(sat)}	-	1.0	1.4	Vdc

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

	Characteristic			Symbol	Min	Тур	Max	Unit
SMALL-SIGNAL CHAP	RACTERISTICS						and astroly and	SI
Current-Gain — Bandy (I _C = 50 mAdc, V _{CE}	width Product(2) = 10 Vdc, f = 20 MHz)		OR GE	fT	60	100	_	MHz
Input Capacitance (VBE = 0.5 Vdc, IC	= 0, f = 1.0 MHz)	MM4036, MI	M4037	Cibo	-	60	e Voltage	pF
Collector-Base Capacitance (VCB = 10 Vdc, I _E = 0, f = 1.0 MHz)		MM4036	1.0	C _{cb}		20	rentD	pF
		MM4037		d9	-0186	20		otal Device
SWITCHING CHARAC	TERISTICS	3°Was	6.71				3.95 840	Derate ab
Turn-On Time	(V _{CC} = 30 Vdc, I _C = 19 I _{B1} = 15 mAdc)	50 mAdc,	7.6	ton	_355	40	75	ns

Turn-On Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc, I _{B1} = 15 mAdc)	ton	_00	40	75	ns is stand
Turn-Off Time	$(V_{CC} = 6.0 \text{ Vdc}, I_{C} = 150 \text{ mAdc}, I_{B1} = I_{B2} = 15 \text{ mAdc})$	toff	-	110	175	ns

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

		ELECTRICAL CHARACTERISTICS (TA = 25°C enlass otherwise noted.)

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

4

MM4257 MM4258

CASE 22-03, STYLE 1 TO-18 (TO-206AA)





SWITCHING TRANSISTOR

PNP SILICON

MAXIMUM RATINGS

Rating	Symbol	MM4257	MM4258	Unit
Collector-Emitter Voltage	VCEO	6.0	12	Vdc
Collector-Base Voltage	VCBO	6.0	12	Vdc
Emitter-Base Voltage	VEBO	4.5		Vdc
Collector Current — Continuous	Ic	200		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		360 2.06	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD		1.2	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	-65 to +200	

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

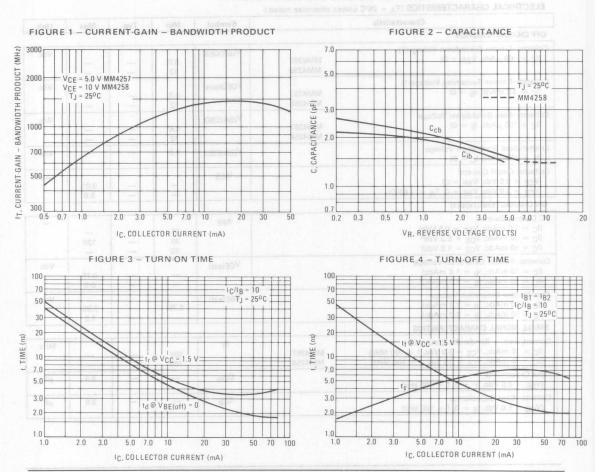
Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS	1.4	UUUNTHIUUN	PERMIT	DAME SALED	0.31	
Collector-Emitter Breakdown Voltage(1) (IC = 100 μAdc, VBE = 0)	MM4257 MM4258	V(BR)CES	6.0 12	=		Vdc
Collector-Emitter Sustaining Voltage(1) (I _C = 3.0 mAdc, I _B = 0)	MM4257 MM4258	VCEO(sus)	6.0	14258	M V BI = 33 3000 = 11	Vdc
Collector-Base Breakdown Voltage (I _C = 100 μAdc, I _E = 0)	MM4257 MM4258	V(BR)CBO	6.0			Vdc
Emitter-Base Breakdown Voltage (IE = 100 μ Adc, IC = 0)		V(BR)EBO	4.5			Vdc
Collector Cutoff Current (VCE = 6.0 Vdc, VBE = 0) (VCE = 3.0 Vdc, VBE = 0, TA = +65°C)	-0.1	ICES	-	=	0.01 5.0	μAdc
ON CHARACTERISTICS(1)	10				111	LLI
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 0.5 Vdc) (I _C = 10 mAdc, V _{CE} = 0.3 Vdc) (I _C = 50 mAdc, V _{CE} = 1.0 Vdc)	50 02	hFE (Ann YE)	15 30 30	16. 20 . 1	_ 120 _	-
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc)	=1 ⁰⁰¹ [11]	VCE(sat)	4-11		0.15 0.5	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, IB = 1.0 mAdc) (IC = 50 mAdc, IB = 5.0 mAdc)	J02 III	VBE(sat)	0.75		0.95 1.5	Vdc
SMALL SIGNAL CHARACTERISTICS					- JAK	
Current-Gain — Bandwidth Product(2) (IC = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz) (IC = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	MM4257 MM4258	fτ	500 700			MHz
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)	5.0	C _{ibo}			3.5	pF
Collector-Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)	0.0	C _{cb}) = ()vol 38 V	10 ht	3.0	pF

			-,	191111	1 17	IVIGA	Unit
SWITCHING CHARACTER	RISTICS						
Turn-On Time	re death		ton	_	10	15	ns
Delay Time	$(V_{CC} = 1.5 \text{ Vdc}, V_{BE} = 0)$ $I_{C} = 10 \text{ mAdc}, I_{B1} = 1.0$	mΔdc)	td	_	5.0	10	ns
Rise Time	(C = 10 MAde, 181 = 1.0	mady	t _r	_	5.0	15	ns
Turn-Off Time	(V _{CC} = 1.5 Vdc,	MM4257 MM4258	toff	_	12 16	15 20	ns
Storage Time		MM4257 MM4258	ts	=	6.0 8.0	15 20	ns
Fall Time		MM4257 MM4258	(t _f)	-	6.0 8.0	10 10	ns
Storage Time (I _C ≈ 10 mAdc, I _{B1} ≈ 1	0 mAdc, l _{B2} ≈ 10 mAdc)	MM4257 MM4258	t _S	2 <u>88</u> c	Continuous stion of T _A	15 20	ns Ins

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) fT is defined as the frequency at which |hfe| extrapolates to unity.

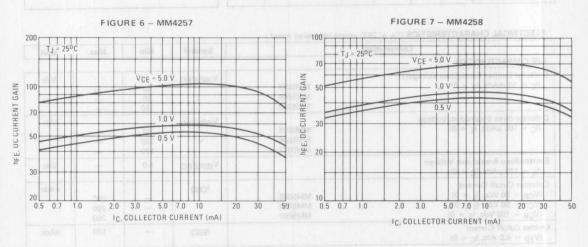
TYPICAL TRANSIENT CHARACTERISTICS

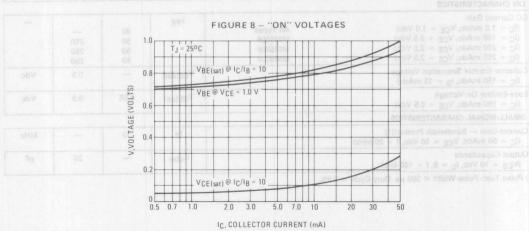


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

R2 R3 1c IB1 IB2 Ohms Ohms Ohms mA mΔ mA 130 10 2.2 k 5 k 1.0 130 2.2 k 10 270 510 390 10 10 10

DC CURRENT GAIN



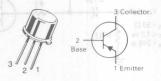


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Rating	Symbol	MM5005	MM5006	MM5007	Unit
Collector-Emitter Voltage	VCEO	60	80	100	Vdc
Collector-Base Voltage	VCBO	80	100	120	Vdc
Emitter-Base Voltage	VEBO		5.0		Vdc
Collector Current — Continuous	Ic		2.0		
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD		1.5 8.57		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	8.0 45.7		Watts mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	1/3	-65 to +200		⊃.°C

MM5005 MM5006 MM5007

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



AUDIO TRANSISTOR

PNP SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteris	tic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	111111111111111111111111111111111111111				
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	MM5005 MM5006 MM5007	V _{(BR)CEO}	60 80 100		Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	MM5005 MM5006 MM5007	V(BR)CBO	80 100 120		Vdc
Emitter-Base Breakdown Voltage (I _E = 100 μAdc, I _C = 0)		V _{(BR)EBO}	5.0		Vdc
Collector Cutoff Current (V _{CB} = 60 Vdc, I _E = 0) (V _{CB} = 80 Vdc, I _E = 0) (V _{CB} = 100 Vdc, I _E = 0)	MM5005 MM5006 MM5007	ICBO	0.0 _ 0.0 001.55108.0	200 200 200	nAdc
Emitter Cutoff Current (V _{EB} = 4.0 Vdc, I _C = 0)		IEBO		100	nAdc
ON CHARACTERISTICS					
DC Current Gain (IC = 1.0 mAdc, V _{CE} = 1.0 Vdc) (IC = 150 mAdc, V _{CE} = 2.5 Vdc) (IC = 200 mAdc, V _{CE} = 2.5 Vdc) (IC = 250 mAdc, V _{CE} = 2.5 Vdc)	All Types MM5005 MM5006 MM5007	PARE THE	40 50 50 50	250 250 250	-
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	01 8131 9 (66)	VCE(sat)	k0 —	0.5	Vdc
Base-Emitter On Voltage (I _C = 150 mAdc, V _{CE} = 2.5 Vdc)	Anj - 904 m d	V _{BE(on)}	0.65	0.8	Vdc
SMALL-SIGNAL CHARACTERISTICS			1		
Current-Gain — Bandwidth Product(1) (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)		fΤ	30	FIF	MHz
Output Capacitance (VCB = 10 Vdc, IF = 0, f = 100 kHz)		C _{obo}	<u>-</u>	20	pF

FIGURES - SWITCHING TIME TEST CIRCUIT

⁽¹⁾ Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	50	Vdc
Collector-Emitter Voltage	VCES	60	Vdc
Collector-Base Voltage	VCBO	75	Vdc
Emitter-Base Voltage	VEBO	5.0	Vdc
Collector Current — Continuous	IC	2.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C		1.0 5.71	Watt mW/°C
Total Device Dissipation $@T_{\mathbb{C}} = 25^{\circ}\text{C}$ Derate above 25°C	0 1000	4.0 22.8	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	0° 0.0

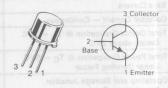
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	44 ×	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	175	°C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

MM5262

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



GENERAL PURPOSE TRANSISTOR

NPN SILICON

Refer to 2N3724 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Chara	cteristic	t beton sawnento	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS							
Collector-Emitter Breakdown Voltage((I _C = 10 mAdc, I _B = 0)	2) (abat0304		V(BR)CEO	50	ioV grinisis	ng settim s	Vdc
Collector-Emitter Breakdown Voltage (I _C = 1.0 mAdc, V _{BE} = 0)		STEENIN	V(BR)CES	60	-		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	090 ₁	атвемім датвамім	V(BR)CBO	75	10 = 8	150 vdc, 1	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μ Adc, I _C = 0)			V _{(BR)EBO}	5.0	10 = 1	175 Vdc. 1 280 Vdc. 1	Vdc
Collector Cutoff Current (VCB = 75 Vdc, I _E = 0)	083	areante	ІСВО	-	- It	100	μAdc
Collector Cutoff Current (VCE = 60 Vdc, VBE = 0)		MANSOLE	ICES	_	-40 = -40 =	10	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, I _C = 0)	and	Millean	IEBO	-	= 10 Ve	100	μAdc
ON CHARACTERISTICS(2)							
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc)			hFE	35 40	100	Imitter Sat 0 m/Life, Ig ter On Vol	-
(I _C = 1.0 Adc, V _{CE} = 1.0 Vdc)				25	35	V co lo vini t	H = 50
Collector-Emitter Saturation Voltage (I _C = 1.0 Adc, I _B = 100 mAdc)			V _{CE} (sat)	- 504	0.29	0.8	Vdc
Base-Emitter Saturation Voltage (I _C = 1.0 Adc, I _B = 100 mAdc)	T T		V _{BE(sat)}	M 0.8 = 1.3	0.94	1.4	Vdc
SMALL-SIGNAL CHARACTERISTICS					ISHIN GJ.	10 Vdd, f	= goV)
Current-Gain — Bandwidth Product $(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f =$	100 MHz)		f _T	10.1 = 1.0	350	igiH nia V .atiArn 0	
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MH})$	z) (aiftiaR		C _{obo}	10.5 = 100	7.3	on to p ut to V .obArn 9	
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MH	łz)		Cibo		72	-	pF
SWITCHING CHARACTERISTICS				I - Late			
Turn-On Time			ton	-	16	30	ns
Turn-Off Time			toff	_	28	60	ns

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

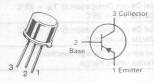
Rating	Symbol	MM5415	MM5416	Unit			
Collector-Emitter Voltage	VCEO	200	300	Vdc			
Collector-Base Voltage	V _{CBO}	200	350	Vdc			
Emitter-Base Voltage	VEBO	4.0	7.0	Vdc			
Base Current	IB	0	50A 0.5				
Collector Current — Continuous	Ic	meW 1	1.0 Q.F				
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD		1.0				
Total Power Dissipation @ T _C = 50°C Linear Derating Factor	PD	10 0.057		Watts mW/°C			
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C			

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	17.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta}JA$	150	°C/W

MM5416

CASE 79-02, STYLE 1 TO-39 (TO-205AD)



TRANSISTOR

PNP SILICON

Refer to 2N5415 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

	Symbol	Min	Max	Unit			
OFF CHARACTERISTICS				761	annato's our	nitter Breedule	- Proposito
Collector-Emitter Sustaining Vo	oltage	VIBRICES	MM5415 MM5416	VCEO(sus)	200 300	mAdo, Ig = 0 nime=Brackda	Vdc
Collector Cutoff Current (VCE = 150 Vdc, I _B = 0)	- 76	У(вя)сво	MM5415, MM5416	ICEO	n Vollage	50	μAdc
Collector Cutoff Current (V _{CE} = 175 Vdc, I _E = 0) (V _{CE} = 280 Vdc, I _E = 0)	6.0	Qasusa)V	MM5415 MM5416	СВО	Voltage	50 50	μAdc μAdc
Emitter Cutoff Current (V _{BE} = 4.0 Vdc, I _C = 0) (V _{BE} = 7.0 Vdc, I _C = 0)		-080F	MM5415 MM5416	IEBO		20	-
ON CHARACTERISTICS					10	BEX WHY V	500
DC Current Gain (I _C = 50 mAdc, V _{CE} = 10 V	dc)	063	MM5415 MM5416	hFE	30 30	150 120	-
Collector-Emitter Saturation Vo		934	MM5415, MM5416	V _{CE(sat)}	(abV 0.1 =	2.5 SDAm	Vdc
Base-Emitter On Voltage (IC = 50 mAdc, VCE = 10 V	35		MM5415, MM5416	V _{BE(on)}	(56V 9.1 - (56V 0.		Vdc
SMALL-SIGNAL CHARACTERI	STICS	VCE(sat)	ease clothes opinion vonage				
Current-Gain — Bandwidth Pro (I _C = 10 mAdc, V _{CE} = 10 V		MHz)		fT	15	v Seturation V	MHz
Output Capacitance (V _{CB} = 10 Vdc, f = 1.0 MHz	z)			C _{obo}	epinalikan		pF ₁
Current Gain — High Frequence ($I_C = 5.0 \text{ mAdc}$, $V_{CE} = 10 \text{ N}$		kHz)		hfe	25	= 30V pb/m	(4 <u>0</u> = 50 r
Real Part of Input Impedance (I _C = 5.0 mAdc, V _{CE} = 10 \	/dc, f = 1.0	MHz)		Re(hie)	W 0.V = 1	300	Ohms
72 - 25		edia				BOTTO	COLUMN YES

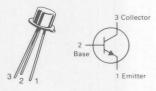
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	VCEO	40	Vdc
Collector-Base Voltage	VCBO	50	Vdc
Emitter-Base Voltage	VEBO	12	Vdc
Collector Current — Continuous	IC	300	mAdd
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	375 2.14	mW W/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.25 7.15	Watts W/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	140	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	467	°C/W

MM6427

CASE 22-03, STYLE 1 TO-18 (TO-206AA)



DARLINGTON TRANSISTOR

NPN SILICON

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	40	-	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	V(BR)CBO	50	-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)	V(BR)EBO	12		Vdc
Collector Cutoff Current $(V_{CB} = 30 \text{ Vdc}, I_E = 0)$	ІСВО	=	100	nAdc
Emitter Cutoff Current (V _{BE} = 10 Vdc, I _C = 0)	IEBO	-	100	nAdc
ON CHARACTERISTICS(1)		HENVI.	-1111	
DC Current Gain (I _C = 10 mAdc, V_{CE} = 5.0 Vdc) (I _C = 100 mAdc, V_{CE} = 5.0 Vdc)	hFE	5000 10,000	=	-
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 0.1 mAdc)	VCE(sat)	-	1.5	Vdc
Base-Emitter On Voltage ($I_C = 100 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$)	V _{BE(on)}	- 1	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 100 \text{ kHz}$)	C _{obo}	-	8.0	pF
Input Capacitance ($V_{BE} = 0.5 \text{ Vdc}$, $I_{C} = 0$, $f = 100 \text{ kHz}$)	C _{ibo}	-	15	pF
Small-Signal Current Gain(1) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	h _{fe}	1.25		-

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MINGGZT

CASE 22-03, STYLE 1 YO-18 (TO-206AA)





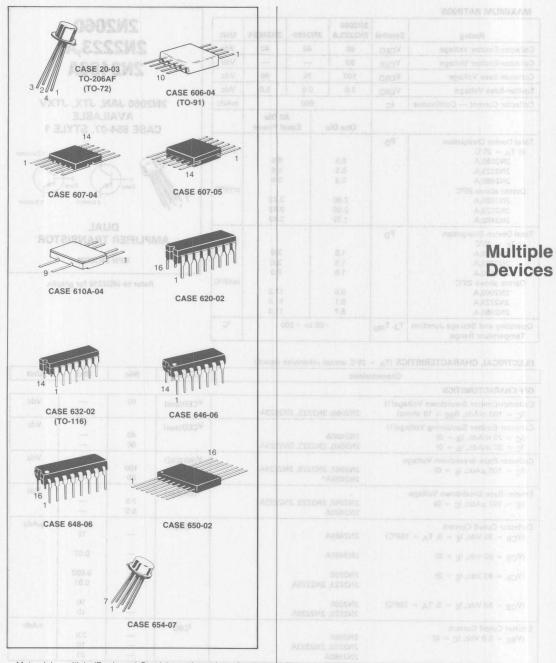
DARLINGTON TRANSISTOR

MAXIMUM RATINGS

THERMAL CHARACTERISTICS

ENTREMENT CHARACTERISTICS (IA = 28°C doings ofherwise noted

(1) Pulsa Tast: Pulsa Width & 300 μs. Duty Cycle € 2.0%.



Motorola's multiple (Duals and Quads) transistors have been implemented with discrete transistor chips that have proven to be the most popular for all-around performance at low cost. Packaging options include plastic and ceramic DIP's, ceramic

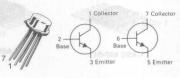
flat pak, and various metal-can outlines.

5-1

Collector-Emitter Voltage	VCER	80	_		Vdc
Collector-Base Voltage	VCBO	100	75	80	Vdc
Emitter-Base Voltage	VEBO	7.0	5.0	5.0	Vdc
Collector Current — Continuous	Ic		500		mAdo
		One Die	Eq	All Die ual Power	
Total Device Dissipation @ T _A = 25°C 2N2060,A 2N2223,A	PD	0.5 0.5		0.6 0.6	mW
2N2480,A Derate above 25°C 2N2060,A 2N2223,A 2N2480,A		2.86 2.86 1.72		0.6 3.43 3.43 3.43	mW/°(
Total Device Dissipation @ T _C = 25°C 2N2060,A 2N2223,A 2N2480,A Derate above 25°C 2N2060,A 2N2223,A 2N2480,A	PD	1.5 1.6 1.0 8.6 9.1 5.7		3.0 3.0 2.0 17.2 11.4	Watts
Operating and Storage Junction	T _J , T _{stg}	-65 to +200		°C	

2N2480A

2N2060 JAN, JTX, JTXV AVAILABLE CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MD2218 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		100000000000000000000000000000000000000			21
Collector-Emitter Breakdown Voltage(1) (I _C = 100 mAdc, R _{BE} ≤ 10 ohms)	2N2060, 2N2223, 2N2223A	VCER(sus)	80	E 632-02	Vdc
Collector-Emitter Sustaining Voltage(1) (I _C = 20 mAdc, I _B = 0) (I _C = 30 mAdc, I _B = 0)	2N2480A 2N2060, 2N2223, 2N2223A	VCEO(sus)	40 60	(911-0)	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	2N2060, 2N2223, 2N2223A 2N2480A*	V(BR)CBO	100 80		Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	2N2060, 2N2223, 2N2223A 2N2480A	V(BR)EBO	7.0 5.0		Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0, T _A = 150°C)	2N2480A	СВО		30-11A-3 3 15	μAdd
$(V_{CB} = 60 \text{ Vdc}, I_E = 0)$	2N2480A		_	0.02	
$(V_{CB} = 80 \text{ Vdc}, I_{E} = 0)$	2N2060 2N2223, 2N2223A		Z Z	0.002 0.01	
$(V_{CB} = 80 \text{ Vdc}, I_{E} = 0, T_{A} = 150^{\circ}\text{C})$	2N2060 2N2223, 2N2223A			10 15	
Emitter Cutoff Current $(V_{BE} = 5.0 \text{ Vdc}, I_C = 0)$	2N2060	IEBO	CASE	2.0	nAdo
	2N2223, 2N2223A 2N2480A			10	

ShU noM niM Cl	haracteri	stic		Symbol	Min	Max	Unit
ON CHARACTERISTICS	1 799	1					olse Figure
DC Current Gain				hFE	Joby 01-	apV abAc	E.0 = 3
$(I_{C} = 10 \mu Adc, V_{CF} = 5.0 Vdc)$		2N2060			25	75	H3 = 610
1.85		2N2223, 2N2223A		2N248	15	0,1 = W8.x	0.001 = 1
						anV sbAm	8.0 = -0
$(I_C = 100 \mu Adc, V_{CE} = 5.0 Vdc)$		2N2060			30	90	112 = 510
0.8		2N2223. 2N2223A		20206	25	150	W 0 1 - 1
		2N2480A			35	anV-shAre	8.0 = 50
		2.12.100.1				200	100
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		2N2060			40	120	001 - 1
IC		2N2480A			EO	200	
		211210071			SUDITA	ASTONAL AND	PLAHING
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$		2N2060			50	150	Inemail 3
0.1		2N2223, 2N2223A		2N208	50	200	1 c - 100
2 . 2 . 02	-	ZITZZZO, ZITZZZOA	S SNZ48UA	2.5.075	50	200	
Collector-Emitter Saturation Voltage				VCE(sat)			Vdc
$(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$		2N2060A		20208	5.0 V dat -	0.6	0.1 = 51
0.5		2N2060, 2N2223, 2N22	223A, 2N2480A	ENCIAC	-	1.2	
Base-Emitter Saturation Voltage				VBE(sat)	_	0.9	Vdc
$(I_C = 50 \text{ mAdc}, I_B = 5.0 \text{ mAdc})$		2N2060, 2N2223, 2N22	223A, 2N2480A	DE(3dt)	Islinere	uin adalok	BUT HE DERIVE
SMALL-SIGNAL CHARACTERISTICS	1		Care and Care	PER INC.	CODY CLE	SOV SPAN	THE STORY
		6700	D, ZNZOBOA, ZNZ	Enclus	1-932 O. 7	SAV ABAR	In Labor
Current-Gain — Bandwidth Product				fT		30V JOHN	MHz
$(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc},$		2N2223, 2N2223A, 2N	2480A	DB2312	50		
f = 20 MHz)		2N2060		nge Due to Ten	60	Voi re ja Dit	SerEmitte
Output Capacitance	14			Cobo	5.0 vdc.	BOV ODAL	pF
(V _{CB} = 10 Vdc, I _F = 0, f = 1.0 MH	47)	2N2060, 2N2060A, 2N	2223 2N2223A	DOODENZO	(3	15	P
(,CB	1-7	2N2480A	ASSESSES, E	2N222		18	
		214240071	7.0	the Mile			
Input Capacitance			300	Cibo	an dise of	85	pF
$(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ M})$	Hz)	2N2060, 2N2223A, 2N	2480A	Asher State on L	and all are an	telen Bi- A P	- Thirties
Input Impedance				hie		milmes and	ohms
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc},$		2N2060		133	1000	4000	
f = 1.0 kHz)		2N2480A			1000	5000	
				h.,			
Input Impedance		ONIGORO ONIGORO ONIGO	2224	hib	20	20	ohms
$(I_C = 1.0 \text{ mAdc}, V_{CB} = 5.0 \text{ Vdc},$		2N2060, 2N2223, 2N2	223A		20	30	
f = 1.0 kHz)		2N2480A			20	35	
Voltage Feedback Ratio				h _{rb}	_	3.0	X 10-4
$(I_C = 1.0 \text{ mAdc}, V_{CB} = 5.0 \text{ Vdc},$				- 1 mail me			1.6
f = 1.0 kHz		2N2223, 2N2223A					
Small-Signal Current Gain	\$ 3804	DEP.	THERRIEUS MOT	h _{fe}	MIAD THE	RUD DO - T	BAUDE
(IC = 1.0 mAdc, VCE = 5.0 Vdc,		2N2060		'ire	50	150	
f = 1.0 kHz)		2N2223, 2N2223A			40	200	
1.0 KHZ)		2N2480A			50	300	1 100
		LITETOUA			30		1 1001
Output Admittance				hoe		16	μmhos
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc},$						THE STATE OF	T WI S
f = 1.0 kHz		2N2060, 2N2480A					6
Output Admittance	f = glot	10 (188)38V - 30 3		hob	The same	0.5	μmhos
				00			J103
		2N2223 2N2223A				THE BUTTON	1-100 8
$(I_C = 1.0 \text{ mAdc}, V_{CB} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz})$		2N2223, 2N2223A					

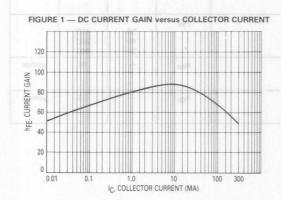
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.) (heunings) 2017214312ARAH2 JAC STORJ3

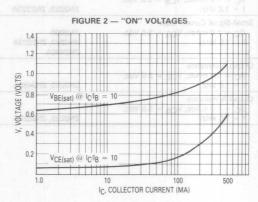
sinU xelf nill Ch	aracteristic		Symbol	Min	Max	Unit
Noise Figure			NF		CTERISTICS	dB
(IC = 0.3 mAdc, VCE = 10 Vdc, RS = 510 Ω , f = 1.0 kHz, BW = 1.0 Hz)	2N2480A	0 3. 2N2223A	2N206 2N206	5.0 Vdci	8.0	OC Current (Itg. = 13)
(I _C = 0.3 mAdc, V_{CE} = 10 Vdc, R _S = 510 Ω , f = 1.0 kHz, BW = 200 Hz) (I _C = 0.3 mAdc, V_{CE} = 10 Vdc, R _S = 1.0 k Ω , f = 1.0 kHz, BW = 15.7 kHz)(2)	2N2060	3, 2W2223A 0A	29/206 29/22 29/248 29/248	6.0 Veld	8.0 8.0	
MATCHING CHARACTERISTICS		A0	BRENE			
DC Current Gain Ratio(3) (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc)	2N2060, 2N2223A	0 3, EN2223A	hFE1/hFE2	(sbV 0.2 0.9	1.0	or 30
	2N2223, 2N2480A			0.8	1.0	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	2N2060 2N2480		2N206 2N206	0.9	1.0 1.0	11G = 51
Base-Emitter Voltage Differential	(Isa)98V	consist accordance of	VBE1-VBE2	spelleV	godenited i	mVdc
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N2060, 2N2223A, 2N2	2480A	pus.yrs	O mAdo)	5.0	OLD TEAMS
$(I_{C} = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	2N2223 2N2060, 2N2060A, 2N2 2N2480	2480A	ecene	th Product	5.0	is 3-Inemut
Base-Emitter Voltage Differential Cha	nge Due to Temperature	0	Δ(VBE1-VBE2)		158	μV/°C
$(I_C = 100 \mu\text{Adc}, V_{CE} = 5.0 \text{Vdc}, T_A = -55^{\circ}\text{C to} + 125^{\circ}\text{C})$	2N2060 2N2223, 2N2223A 2N2480A		ΔΤ	$0.0.\overline{T} = 1.$	10 25 15	Autput Cap (Vcg = 1

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) Amplifier: 3.0 dB points at 25 Hz and 10 kHz with a roll-off of 6.9 dB per octave.

(3) The lowest hFE reading is taken as hFE1 for this ratio.





2N2453,A

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N2920 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Symbol

VCEO

VCBO

VEBO

IC

PD

PD

TJ, Tstg

2N2453 2N2453A

7.0

50

One Die Both Die

-65 to +200

50

80

300

1.71

1200

6.86

30

60

1.14

600

3.43

Unit

Vdc

Vdc

Vdc

mAdc

mW

mW/°C

mW

mW/°C

°C

MAXIMUM RATINGS
Rating

Collector-Emitter Voltage

Collector Current — Continuous

Total Device Dissipation @ $T_A = 25$ °C

Total Device Dissipation @ $T_C = 25^{\circ}C$ Derate above 25°C

Operating and Storage Junction

Collector-Base Voltage

Emitter-Base Voltage

Derate above 25°C

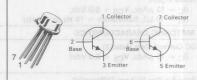
Temperature Range

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	as Duty Cuelo < 2.0%	dth < 300	st: Pulse W	Fulse Ta
Collector-Emitter Sustaining Voltage(1) (IC = 10 mAdc, IB = 0) 2N2453 2N2453A	VCEO(sus)	30 50	Euipeer Tst	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0) 2N2453 2N2453A	V(BR)CBO	60 80	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 0.1 \mu Adc, I_C = 0$)	V(BR)EBO	7.0	-	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 150°C)	СВО	-	0.005 10	μAdc
Emitter Cutoff Current (V _{BE} = 5.0 Vdc, I _C = 0)	IEBO	-	0.002	μAdc
ON CHARACTERISTICS				
DC Current Gain $ \begin{aligned} &(I_C = 10 \; \mu \text{Adc, V}_{CE} = 5.0 \; \text{Vdc}) \\ &(I_C = 10 \; \mu \text{Adc, V}_{CE} = 5.0 \; \text{Vdc, T}_{A} = -55^{\circ}\text{C}) \\ &(I_C = 1.0 \; \text{mAdc, V}_{CE} = 5.0 \; \text{Vdc}) \\ &(I_C = 1.0 \; \text{mAdc, V}_{CE} = 5.0 \; \text{Vdc, T}_{A} = -55^{\circ}\text{C}) \end{aligned} $	hFE	80 40 150 75	— 600 —	-
Collector-Emitter Saturation Voltage (I _C = 5.0 mAdc, I _B = 0.5 mAdc)	VCE(sat)	-	1.0	Vdc
Base-Emitter Saturation Voltage ($I_C = 5.0 \text{ mAdc}$, $I_B = 0.5 \text{ mAdc}$)	V _{BE} (sat)	-	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 10 Vdc, f = 30 MHz)	fT	60	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 140 kHz)	C _{obo}	-	8.0	pF
Input Capacitance (VBE = 0.5 Vdc, I_C = 0, f = 140 kHz)	C _{ibo}	-	10	pF
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	h _{ie}	5.0	-	kohms
Input Impedance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	h _{ib}	20	30	Ohms

	0 mAdc, VCE		c, f = 1.0 kHz)					h _{re}	_	6.0	X 10-4
	eedback Ration		c, f = 1.0 kHz)					h _{rb}		5.0	X 10-4
0	nal Current (0 mAdc, V _{CE}		c, f = 1.0 kHz)	field	AEBISHS	2NSM62	Synatro	hfe	150	600	Jeni X Ano
Output Ad (I _C = 1.		E = 5.0 Vd	c, f = 1.0 kHz)	3bV	08	30	OBOV	h _{oe}	5.0	30	μmho
Output Ac (I _C = 1.		B = 5.0 Vd	c, f = 1.0 kHz)	Vele		7.0	OUSV	h _{ob}		0.2	μmho
Noise Figu (I _C = 10		= 5.0 Vdc	, R _S = 10 k Ω , f =	1.0 kHz)		eid and		NF		7.0	dB
MATCHIN	IG CHARACT	TERISTICS	ANFIL	Win	360	200	1 94	25°C	AT a no	te Dissipet	oral Devi
$(I_C = 10)$ $(I_C = 1)$	nt Gain Ratio 00 μAdc, V _{CI} .0 mAdc, V _{CI} .0 mAdc, V _{CI}	E = 5.0 Vd E = 5.0 Vd			12453A	8.43 8.43 - 66 to	nt Tu T	FE1/hFE2	0.90 0.90 0.85	1.0 1.0 1.0	Derote a person of the contract of the contrac
	tter Voltage I 0 μAdc, VCF						VE	BE1-VBE2	_	3.0	mVd
	.0 mAdc, VCI								_	5.0	
(I _C = 1. Base-Emit	.0 mAdc, V _{CI}	E = 5.0 Vd Differential	c)		N2453 N2453A	iwierito exe	<u>Δ(V</u>	BE1-VBE2) ΔΤ _Α	TACTERIS	10 5.0	μV/°0
$(I_C = 1.$ Base-Emit $(I_C = 10)$ Pulse Te	tter Voltage I 0 μAdc, V _{CE} est: Pulse Wi	$E = 5.0 \text{ Vd}$ Differential} $= 5.0 \text{ Vdc}$ $dth \leq 300$	Gradient TA = -55° C to μ s, Duty Cycle ≤ 1	2.0%.	12453	iwierito exe		ΔΤΑ	838	10 5.0	HD RI
$(I_C = 1.$ Base-Emit $(I_C = 10)$ Pulse Te	tter Voltage I 0 μAdc, V _{CE} est: Pulse Wi	$E = 5.0 \text{ Vd}$ Differential} $= 5.0 \text{ Vdc}$ $dth \leq 300$	Gradient, $T_A = -55^{\circ}C$ to	2.0%.	12453 12453A	ess otherwi		ΔΤΑ	SUS Laining Voi	10 5.0	FF CHU R
$(I_C = 1.$ Base-Emit $(I_C = 10)$ Pulse Te	tter Voltage I 0 μAdc, V _{CE} est: Pulse Wi	E = 5.0 Vd Differential $= 5.0 Vdc$ $= 5.0 Vdc$ $= 5.0 Vdc$ $= 5.0 Vdc$	Gradient TA = -55° C to μ s, Duty Cycle ≤ 1	2.0%.	N2453 N2453A	2N24		ΔT _A	taining Vol = 0)	AMO IAC 10 5.0 Elizabentos	Hector B
(I _C = 1. Base-Emit (I _C = 10) Pulse Te) Lowest I	tter Voltage I 0 μAdc, V _{CE} est: Pulse Wi	E = 5.0 Vd Differential = 5.0 Vdc dth ≤ 300 is taken as	Gradient, $T_A = -55^{\circ}C$ to μ s, Duty Cycle $\leq h_{FE1}$ for this ratio	2.0%.	N2453 N2453A	2N2d 2N2d 2N2d		(Pleger	taining Voltage (0) = 0) solve Voltage	ANO JAC 10 5.0 distribution at other at other at other at other	Hestor B
(IC = 1. Base-Emit (IC = 10)) Pulse Te () Lowest I	ter Voltage I 0 µAdc, V _{CE} est: Pulse Wi h _{FE} reading	E = 5.0 Vd Differential = 5.0 Vdc dth ≤ 300 is taken as	Gradient, $T_A = -55^{\circ}\text{C}$ to μs , Duty Cycle \leq hFE1 for this ratio	2.0%.	N2453 N2453A	2N2d 2N2d 2N2d		ΔT _A	taining Voltaining oltaining voltaining voltaining voltaining voltaining voltainin voltaining voltaining voltaining voltaining voltaining voltaining voltaining voltaining voltaining voltaining voltaining volta	AHD IAC 10 5.0 Chia and marker and and and and and and and and and and	Hector 5 (NE = 10 (NE
(I _C = 1. Base-Emit (I _C = 10)) Pulse Te (I _C = 10) Above the second sec	ter Voltage I	E = 5.0 Vd Differential = 5.0 Vdc dth ≤ 300 is taken as	Gradient, $T_A = -55^{\circ}C$ to μ s, Duty Cycle \leq hFE1 for this ratio	2.0%.	N2453 N2453A	2N2d 2N2d 2N2d		ΔT _A	SUB (a) (a) (b) (b) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c	AHD IAC 10 5.0 Chia and marker and and and and and and and and and and	Hector College
(IC = 1. Base-Emit (IC = 1() Pulse Te) Lowest I	ter Voltage I	E = 5.0 Vd Differential = 5.0 Vdc dth ≤ 300 is taken as	Gradient, $T_A = -55^{\circ}\text{C}$ to μ s, Duty Cycle $\leq 10^{\circ}$ h _{FE1} for this ratio	2.0%.	N2453 N2453A	2N2d 2N2d 2N2d		ΔT _A	2008 = 0) town Voltage = 0; voltage = 0; TA = 0; TA = 0;	AND LACE TO SEE THE SE	He and He was a state of the st

thru 2N2644

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N2913 for graphs.

65

130

VCE(sat)

1.0

Vdc

MAXIMUM RATINGS Rating Symbol Value Unit Collector-Emitter Voltage VCEO 45 Vdc 45 Vdc Collector-Base Voltage **VCBO** Emitter-Base Voltage **VEBO** 5.0 Vdc Collector Current — Continuous 30 IC mAdc One Die Both Die Total Device Dissipation @ TA = 25°C 300 600 mW PD mW/°C Derate above 25°C 1.72 3.43 Total Device Dissipation @ T_C = 25°C mW PD 600 1200 Derate above 25°C 3.43 6.87 mW/°C °C Operating and Storage Junction TJ, Tstg -65 to +200

Temperature Range

 $(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$

Collector-Emitter Saturation Voltage

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) Characteristic Symbol Min Max Unit OFF CHARACTERISTICS Collector-Emitter Sustaining Voltage(1) VCEO(sus) 45 Vdc $(I_C = 10 \text{ mAdc}, I_B = 0)$ Collector Cutoff Current 0.010 ICEO μAdc $(V_{CE} = 5.0 \text{ Vdc}, I_B = 0)$ Collector Cutoff Current ІСВО μAdc 0.010 $(V_{CB} = 45 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 45 \text{ Vdc}, I_{E} = 0, T_{A} = +150^{\circ}\text{C})$ 10 **Emitter Cutoff Current IEBO** 0.010 μAdc $(V_{EB} = 5.0 \text{ Vdc}, I_{C} = 0)$ ON CHARACTERISTICS(1) DC Current Gain hFE $(I_C = 10 \, \mu Adc, V_{CE} = 5.0 \, Vdc)$ 2N2639, 2N2640, 2N2641 50 300 2N2642, 2N2643, 2N2644 100 300 $(I_C = 10 \mu Adc, V_{CE} = 5.0 Vdc, T_A = -55^{\circ}C)$ 2N2639, 2N2640, 2N2641 10 2N2642, 2N2643, 2N2644 20 $(I_C = 100 \, \mu Adc, V_{CE} = 5.0 \, Vdc)$ 2N2639, 2N2640, 2N2641 55 2N2642, 2N2643, 2N2644 110

$(I_C = 10 \text{ mAdc}, I_B = 0.5 \text{ mAdc})$	OE(Sut)			
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 0.5 \text{ mAdc}$)	V _{BE(sat)}	0.6	1.0	oŁV
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 20 MHz)	fT	40	-	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo}	-	8.0	pF
Input Impedance (I _C = 1.0 mAdc, V_{CB} = 5.0 Vdc, f = 1.0 kHz, I _E = -1.0 mA)	h _{ib}	25	32	ohms
Voltage Feedback Ratio ($I_C = 1.0 \text{ mAdc}$, $V_{CB} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$, $I_E = -1.0 \text{ mA}$)	h _{rb}	_	600	X 10-6

2N2639, 2N2640, 2N2641

2N2642, 2N2643, 2N2644

Characteristic Symbol Min Unit hfe Small-Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CB} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz})$ 2N2639, 2N2640, 2N2641 65 600 2N2642, 2N2643, 2N2644 130 600 μmhos Output Admittance hob 1.0 ($I_C = 1.0 \text{ mAdc}$, $V_{CB} = 5.0 \text{ Vdc}$, f = 1.0 kHz, $I_E = -1.0 \text{ mA}$)

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}C$ unless otherwise noted.)

Noise Figure NE 4.0 dB $(I_C = 10 \, \mu Adc, V_{CB} = 5.0 \, Vdc,$ $R_S = 10 \text{ k}\Omega$, Bandwidth = 10 Hz to 15 kHz)

MATCHING CHARACTERISTICS	1 000	Osor		organio e ora	
DC Current Gain Ratio(2) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	2N2639, 2N2642 2N2640, 2N2643	hFE1/hFE2	0.9	1.0	D sozoalio
Base-Emitter Voltage Differential (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	2N2639, 2N2642 2N2640, 2N2643	VBE1-VBE2	= AT ®	5.0 10	mVdc
Base-Emitter Voltage Differential Gradient (IC = 10 μ Adc, VCE = 5.0 Vdc, TA = -55	to + 125°C) 2N2639, 2N2642 2N2640, 2N2643	Δ (V _{BE1} -V _{BE2}) Δ T _A	noitanyl	10,	μV/°C

(1) Pulse Test:	Pulse Width	\leq 300 μ s, Duty	Cycle ≤ 2.0%.
(2) The lowest	hFE reading	is taken as hFE	for this test.

2N2721

MAXIMUM RATINGS

Rating	Symbol	Va	Unit			
Collector-Emitter Voltage	VCEO	6	60	Vdc		
Collector-Base Voltage	VCBO	100		Vdc		
Emitter-Base Voltage	VEBO	7.0		7.0		Vdc
Collector Current — Continuous	lc -	500		mAdc		
. vermind E vermind E		One Die	Both Die			
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.3 1.72	0.6 3.43	Watt mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 5.7	2.0	Watts mW/°C		
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C		

2N2652,A

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N2060,A for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

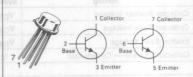
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		Di Di	eraustras	NAME OF STREET
Collector-Emitter Breakdown Voltage(1) (I _C = 20 mAdc, I _B = 0)	V(BR)CEO	60	Andrew Season	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	V(BR)CBO	100	Samuel States	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	V(BR)EBO	7.0		Vdc
Collector Cutoff Current (VCB = 50 Vdc, IE = 0) (VCB = 50 Vdc, IE = 0, T_A = 150°C)	ICBO	= 8376	0.010 15	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, I _C = 0) 2N2652	IEBO	-	0.010	μAdc
ON CHARACTERISTICS	Globert Law	SAL DAY	will made	market 1
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, T _A = -55° C)	bbV 0 bFE 33V	35 50 15	200	-
Collector-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 5.0 mAdc)	V _{CE(sat)}	annillati s	1.2	Vdc
Base-Emitter Saturation Voltage (I _C = 50 mAdc, I _B = 5.0 mAdc)	V _{BE} (sat)	THE TANK	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	ladam Of the old the	altis Peculia	whereB of	nal-ingym
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	fr	60	sonston	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz)	Cobo	20 A cm (G 2 cm	15	pF
Input Capacitance (VBE = 0, 0.5 Vdc, I _C = 0, f = 1.0 MHz)	Cibo		85	pF
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hie	1.0	10.5	kohm
Input Impedance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	hib	20	35	ohms
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hfe	50	300	60054. VV 0.
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hoe	- 10	50	μmho
Noise Figure (IC = 0.3 mAdc, V_{CE} = 10 Vdc, R_S = 610 ohms, B. W. = 1.0 Hz, f = 1.0 kHz)	NF	SpV (50 =	8.0 M	dB
MATCHING CHARACTERISTICS		ifferential	o Voltage D	nim3-se
DC Current Gain Ratio(2) $(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$ 2N2652 $(I_C = 1.0 \ mAdc, V_{CE} = 5.0 \ Vdc)$ 2N2652	hFE1/hFE2	0.85 0.85	1.0	01 #_50
Base-Emitter Voltage Differential (I _C = 100 µAdc, V _{CE} = 5.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	VBE1-VBE2	Isimpeth by 0.3 =	3.0	mVdc
Base-Emitter Voltage Differential Gradient (IC = 100μ Adc, VCE = 5.0 Vdc , TA = $-55 \text{ to } + 125^{\circ}\text{C}$)	$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_{A}}$	= 5.0 Vdc	10	μV/°C

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) The lowest of the two hFE readings is taken as hFE1 for the purpose of measurement. a gray which are COC a distributed and the second of the two hFE readings is taken as hFE1 for the purpose of measurement.

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	60		Vdc
Collector-Base Voltage	VCBO	8	80	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current — Continuous	Ic	40		mAdc
JAUG		One Die	Both Die	0.0
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.3 1.71	0.6 3.4	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.6 3.4	1.2 6.8	Watt mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200		°C

CASE 654-07, STYLE 1



DUAL **AMPLIFIER TRANSISTOR**

NPN SILICON

Refer to 2N2060 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

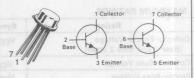
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	60	10 TO 10 TO	Vdc
Collector Cutoff Current (VCE = 5.0 Vdc, IB = 0)	ICEO	and v stava	10	nAdc
Collector Cutoff Current $(V_{CB} = 60 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 60 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$	СВО	nt (Ves	0.01	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, IC = 0)	IEBO	3071	10	nAdc
ON CHARACTERISTICS				
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	98V 0.8 = 30V .3	30 35 42	120 	m-mu <mark>O</mark> Di
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)	Well Off	1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE} (sat)	0.65	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS	BL SOWIN ME - SH		Market Care	NAME OF PARTY
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	ÍΤ	80	The state of the s	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	Cobo	CALL PROPERTY	6.0	pF
Input Impedance (IE = 1.0 mAdc, VCB = 5.0 Vdc, f = 1.0 kHz)	hib	25	32	ohms
Voltage Feedback Ratio (I _E = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	h _{rb}	10 10 10 10	500	X 10-6
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	h _{fe}	30	200	The state of
Output Admittance (I _E = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	h _{ob}	-	1.0	μmhos
MATCHING CHARACTERISTICS	e + 40 a tonvero e t	July 11101	A HEADOW	u.B. et annui
DC Current Gain Ratio(2) (IC = 100 μ Adc, VCE = 5.0 Vdc)	hFE1/hFE2	0.8	1.0	0 = 31)
Base-Emitter Voltage Differential	V _{BE1} -V _{BE2}	801181FB	DARACO	mVdc
(I _C = 100 μ Adc, V _{CE} = 5.0 Vdc)		2) (lg = 000	della Fisal	G Currant
Base-Emitter Voltage Differential Change Due to Temperature (IC = 100 μ Adc, VCE = 5.0 Vdc, TA = -55 to +25°C)	Itc = 1.0 mAde Vc		Voltage	
			1.6	
$(I_C = 100 \mu\text{Adc}, V_{CE} = 5.0 \text{Vdc}, T_A = +25 \text{to} + 125^{\circ}\text{C})$	s, TA = -55 to -12		apV abAu	oht = all
	es, Dury Cycle e 2.0%	000 	2.0	res seluñ

⁽¹⁾ Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.
(2) The lower of the two h_{FE} readings is taken as h_{FE1} for the purpose of measurement.

Rating	Symbol	Value		Unit		
Collector-Emitter Voltage	VCEO	4	15	Vdc		
Collector-Base Voltage	VCBO	45		45		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc		
Collector Current — Continuous	Ic	40		mAdc		
E4 B 5 T E2		One Die	Both Die			
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.3 1.7	0.6 3.4	Watt mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.6 3.4	1.2 6.8	Watts mW/°C		
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C		

2N2722

CASE 654-07, STYLE 1



DUAL **AMPLIFIER TRANSISTOR**

NPN SILICON

Refer to 2N2920 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		3	OFFERISHE	ARARD TR
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	45, 66	luga a S eptin	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	45	761 <u>D</u> bAs	Vdc
Collector Cutoff Current (VCE = 5.0 Vdc, IB = 0)	ICEO	igsti <u>oV</u> nw	2.0	nAdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 30 Vdc, I _E = 0, T _A = 150°C)	СВО	ago <u>llo</u> V n	0.001 1.0	μAdc
Emitter Cutoff Current (VEB = 5.0 Vdc, IC = 0)	IEBO	- 10	1.0	nAdc
ON CHARACTERISTICS		10 -	60 Vda le	le ranvi
DC Current Gain ($I_C = 1.0 \ \mu Adc, V_{CE} = 5.0 \ Vdc$) ($I_C = 10 \ \mu Adc, V_{CE} = 5.0 \ Vdc$) ($I_C = 0.1 \ m Adc, V_{CE} = 5.0 \ Vdc$)	h _{FE} (3'98)	50 100 125	250	Men Cut
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc)	VCE(sat)		1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 0.5 mAdc)	V _{BE(sat)}	0.65	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS	t laz = 0)	0 = 5.0 Vdc	nAde, Ves	101 = 01
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 20 MHz)	f _T	100	inte l S etui	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	Cobo	BAM U.T -	6.0	pF
Input Impedance (I _E = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	hib	25	32	ohms
Voltage Feedback Ratio (I _E = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	hrb	eronations.	600	X 10-6
Small-Signal Current Gain (I _E = 0.1 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hfe	100	700	telli Car
Output Admittance (IE = 1.0 mAdc, VCB = 5.0 Vdc, f = 1.0 kHz)	hobells of	= 1.0 =	1.0	μmhos
Noise Figure (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 k Ω , f = 10 Hz to 15.7 kHz)	NF	— nie	4.0	dB
MATCHING CHARACTERISTICS	(s) f) = 1.0 (d)(s)	= 5.0 Vdc	nAde, Veez	10! = 3!
DC Current Gain Ratio(2) (I _C = 1.0 μAdc, V _{CE} = 5.0 Vdc)	hFE1/hFE2	0.9		m <u>on</u> t Ga 10 ≠ 10 m
Base-Emitter Voltage Differential (IC = 10 μ Adc, V _{CE} = 5.0 Vdc) (SH 007 = WB SH) 0.1 =	V _{BE1} -V _{BE2}	ge <u>(\(\text{\text{n}} \text{\tetx{\text{\te}\text{\texi}\text{\text{\text{\text{\text{\texi}\text{\text{\texi}\text{\text{\text{\text{\text{\text{\text{\texi}\text{\text{\texi}\text{\t</u>		mVdc
Base-Emitter Voltage Differential Change Due to Temperature (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, T _A = -55 to +25°C) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, T _A = +25 to +125°C)	Δ(V _{BE1} -V _{BE2})	th ≤ 12 m	0.8	mVdc

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%. (2) The lower of the two hFE readings is taken as hFE1 for the purpose of measurement.

2N2722

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage (Base 1 and Base 2 open)	VCE20	60 abv	Vdc
Collector-Base Voltage	V _{CB1}	80	Vdc
Emitter-Base Voltage	V _{E2B1}	12	Vdc
Collector Current — Continuous	IC	40	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.5 2.9	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 10.5	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +200	°C

2N2723

CASE 20-03, STYLE 8 TO-72 (TO-206AF)





DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N998 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					SOLLSWEE	IFF CHARAC
Collector-Emitter Breakdown Volta (I _C = 10 mAdc, I _{B1} = 0)	ge(1)	Vdc 1g = 0)	V(BR)CE2O	of agailov	iter B <u>ra</u> akdor e Breakdown	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_{E2} = 0$)			V(BR)CB10	V 0 8 80 30 V	off Current	Vdc #
Emitter-Base Breakdown Voltage $(I_{E2} = 10 \mu Adc, I_C = 0)$	OBJ		V(BR)E2B10	V 05 12 80 V	A transier	Vdc
Collector Cutoff Current (VCB1 = 60 Vdc, IE = 0)	E0°0\		ICB10	and about 0	0.01	μAdc
(V _{CB1} = 60 Vdc, I _E = 0, T _A = 1 Emitter Cutoff Current (V _{B1E2} = 10 Vdc, I _C = 0)	50 C)		IE2B1O	1 mAde, Vol	10	nAdc
ON CHARACTERISTICS	VCE(sat)	lg = 0.5 mAde)	3594M 97 = 3) sgarlov n	Ter Satureno	M3-10736H
DC Current Gain (IC = 10 mAdc, VCE2 = 5.0 Vdc	, I _{B2} = 0)	(obAm e.t) =	hFE	2000	10,000	MALL SIGN
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB1 = 1.0 mAdc)		VCE = 18 Vdc, f = 20 MHz)	VCE2(sat)		1.0	
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _{B1} = 1.0 mAdc) diff	(sHi) 0.1 -	VBE2(sat)	0 mAge, Vo	1.7 900	Vdc
SMALL-SIGNAL CHARACTERISTIC	S	(SBM 0.1 = 1 dol	A10 - 80 A10	Manu Art - 8	Olion Avec	uoo segent
Output Capacitance (V _{CB1} = 10 Vdc, I _{E2} = 0, f = 14	40 kHz)	(sh(s) 0.7 = 1	C _{ob1o}	CobAra 0.1	10 = gl) sonst	pF
Small-Signal Current Gain (IC = 10 mAdc, VCE2 = 5.0 Vdc	, f = 1.0 kHz)	KO, E = 10 Hz to 16.7 KHz)	h _{fe}	1500	15,000	Mas <u>Figure</u> IATCNING
Current Gain — Bandwidth Production (IC = 10 mAdc, VCE1 or VCE2 =		IHz)	h _{fe}	5.0	ein R esi o(2) Adc. Vos =	
Noise Figure (Input Stage Only) (IC = 50 μAdc, VCE = 5.0 Vdc,	Rs = 3.0 kohms, f	= 1.0 kHz, BW = 100 Hz)	NF		affic 10 stov	

(1) Pulse Test: Pulse Width ≤ 12 ms, Duty Cycle ≤ 2.0%.

Rating	Symbol	Valu	e Unit
Collector-Emitter Voltage (Base 1 and Base 2 open)	VCE2O	40	Vdc
Collector-Base Voltage	V _{CB10}	60	Vdc
Emitter-Base Voltage (Pin 4 to Pin 2)	V _{E2B10}	15 7.5	Vdc
Collector Current — Continuous	Ic	200	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.5	
Total Device Dissipation @ T _C = 25°C Derate above 25°C		1.8	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	+200 °C

2N2785

CASE 20-03, STYLE 8 TO-72 (TO-206AF)





DARLINGTON TRANSISTOR

NPN SILICON

Refer to 2N998 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and applied the activities and applied the activities and applied the activities and applied the activities and applied the activities and applied the activities and applied the activities and applied the activities and applied the activities and activities activities and activities activities and activities and activities activities and activities activities and activities activities and activities activities activities and activities activities activities and activities activ

V(BR)CEO2O V(BR)CBO1O V(BR)E2BO1O ICEO	40 60 15	500	Vdc Vdc Vdc nAdc
V(BR)CB010 V(BR)E2B010 ICE0	60 15	500	Vdc Vdc
V(BR)E2BO1O ICEO	15 DV 38V	500	Vdc
ICEO	VBE = 30 V	consusance	
СВО	70 pAdo, Vo	consusance	nAdc
E = 6.0 Vdc, 7 A =		= nill nia?	
	V .sb <u>A</u> -n 0.1	0.05	μAdc
IEBO	agsalaV ne	20	nAdc
	600 1200 2000	20,000	MALL L-SIG Letront-Gal Julgut Cap
VCE(sat)	.obV <u>8</u> .0 = 1.0 m&dc, V	1.0	Vdc
C _{ob1o}	m = 1.0 m $m = 1.0 m$	30	pF
hib	30	80	Ohms
hrb	= 1.0 mAdc	10	X 10-4
h _{fe}	600	HO-10	ol <u>os</u> Rigue AATCHINA
hfe	B. 1.0 (1)	Sain mario(2	tosmaa 3
hob	erensial Gra	0.5	μmhos
	VCE(sat) Cob1o hib hrb hfe	IEBO	Cob10

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

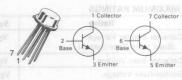
2N2785

MAXIMUM RATINGS

Rating	Symbol	Value		Unit		
Collector-Emitter Voltage	VCEO	30		Vdc		
Collector-Base Voltage	VCBO	60		60 ga		Vdc
Emitter-Base Voltage	VEBO	oby 7.0		Vdc		
Collector Current — Continuous	IC	50		mAdc		
\$ 150 t 3 tg 150 t 3		One Die	Both Die			
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	200 1.14	300 1.71	mW mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.6 3.43	1.2 6.86	Watts mW/°C		
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C		

2N2903

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N2920 for graphs.

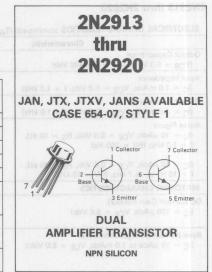
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and problem 3'25. Sept. 2017 2017 218 370 218 370 218 37

Middle Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS		cs cs	RACTERISTN	OFF CHAF
Collector-Emitter Sustaining Voltage(1) (I _C = 10 mAdc, I _B = 0)	V _{CEO(sus)}	30	epil 👊 imi	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V _{(BR)CBO}	60	gi abam	Vdc
Emitter-Base Breakdown Voltage ($I_E = 0.1 \mu Adc, I_C = 0$)	V(BR)EBO	7.0	Sase Breaks	Vdc
Collector Cutoff Current $(V_{CB} = 50 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 50 \text{ Vdc}, I_{E} = 0, T_{A} = 150^{\circ}\text{C})$	ІСВО	getteV nw	0.01 15	μAdc
Emitter Cutoff Current (VBE = 5.0 Vdc, IC = 0)	IEBO	- 10	0.01	μAdc
ON CHARACTERISTICS		(0 =	10 Vdc, Ig	- apvi
DC Current Gain ($I_C = 10 \ \mu Adc$, $V_{CE} = 5.0 \ Vdc$) ($I_C = 10 \ \mu Adc$, $V_{CE} = 5.0 \ Vdc$, $T_A = -55^{\circ}C$) ($I_C = 1.0 \ mAdc$, $V_{CE} = 5.0 \ Vdc$) ($I_C = 1.0 \ mAdc$, $V_{CE} = 5.0 \ Vdc$, $T_A = -55^{\circ}C$)	hFE (3:081	60 25 125 60	625	Oothers C
Collector-Emitter Saturation Voltage (I _C = 5.0 mAdc, I _B = 0.5 mAdc)	V _{CE(sat)}	() = 5	1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 5.0 mAdc, I _B = 0.5 mAdc)	V _{BE} (sat)	- 83	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS			(t)mis3 t	na mu3 30
Current-Gain — Bandwidth Product (IC = 5.0 mAdc, VCE = 10 Vdc, f = 30 MHz)	f _T	60	V Joham C	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 140 kHz)	Cobo	0.2 = 23	8.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 140 kHz)	Cibo	lov doite	10	pF
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hie (ab	1.0	48 2540	kohm
Input Impedance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	hib 2011	20	30	ohms
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	h _{re}	_	6.0	X 10-
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)	hrb	= 1,8 = 5	5.0	X 10-
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hfe	150	600	SDCAT BURN
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 1.0 kHz)	hoe	5.0	30	μmho
Output Admittance ($I_C = 1.0 \text{ mAdc}$, $V_{CB} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	(start hob tob)	0.8 - 63	0.2	μmho
Noise Figure (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 kohms, f = 1.0 kHz)	NF	-mine	7.0	dB
MATCHING CHARACTERISTICS	(de, I = 1.0 MHz)		o mAdo, Vo	1 = 011
DC Current Gain Ratio(2) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	hFE1/hFE2	0.8	1.0) nearming
Base-Emitter Voltage Differential (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	VBE1-VBE2	0.0 4 73	10	mVdd
Base-Emitter Voltage Differential Gradient (IC = 10 μ Adc, V _{CE} = 5.0 Vdc, T _A = -55° C to $+125^{\circ}$ C)	$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_{A}}$	81 = 5.0	20	μV/°C

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ Lowest hee reading is taken as hee1 for this ratio.

MAXIMUM RATINGS				
Sodama O. Rating	Symbol	2N2913 thru 2N2918	2N2919 2N2920	Unit
Collector-Emitter Voltage	VCEO	45	60	Vdc
Collector-Base Voltage	VCBO	45	60	Vdc
Emitter-Base Voltage	VEBO	6.0		Vdc
Collector Current — Continuous	Ic	30 00 00 0		mAdc
8.0 4.0		One Die	Both Die	FIRSH
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.7	500 2.86	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D	750 4.3	1500 8.6	mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	°C	



ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	V-ragVW	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						M = O
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	2N2913 thru 18, 2N2919, 2N2920	V(BR)CEO(sus)	45 60	6V 02 = a	- W 2000	Vdc
Collector-Base Breakdown Voltage (IC = 10 µAdc, IE = 0)	2N2913 thru 18, 2N2919, 2N2920	V(BR)CBO	45 60	25°C) 4th = 300°	T + OF GIES. W DATE I SE	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	168	V(BR)EBO	6.0	KO TK ONI KO SI	- 7 2 3 3 N	Vdc
Collector Cutoff Current (V _{CE} = 5.0 Vdc, I _B = 0)	1 1 1 1 1 1	ICEO	1-14		0.002	μAdo
Collector Cutoff Current (VCB = 45 Vdc, I _E = 0) (VCB = 45 Vdc, I _E = 0, T _A = 150°C)	2N2913 thru 18, 2N2919, 2N2920 All Types	ІСВО	=	=	0.010 0.002	μAdo
Emitter Cutoff Current (VEB = 5.0 Vdc, I _C = 0)	\$ B	IEBO	1-1		0.002	μAdo
ON CHARACTERISTICS						
DC Current Gain(1) (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	2N2913,15,17,19, 2N2914,16,18,20	hFE	60 150		240 600	ar
$(I_C = 10 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_A = -55^{\circ}C)$	2N2913,15,17,19, 2N2914,16,18, 2N2920	AM	15 30 40	to come	=	-101
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N2913,15,17,19, 2N2914,16,18,20		100 225		=	8.0
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	2N2913,15,17,19, 2N2914,16,18,20		150 300			40 9
Collector-Emitter Saturation Voltage (IC = 1.0 mAdc, IB = 0.1 mAdc)		VCE(sat)			0.35	Vdc
Base-Emitter On Voltage (I _C = 100 μAdc, V _{CE} = 5.0 Vdc)		V _{BE(on)}			0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS	11114			THE	MAINTE	2,0
Current-Gain — Bandwidth Product (I _C = 500 μAdc, V _{CE} = 5.0 Vdc, f = 20 MHz)	HH.	fT	60			MHz

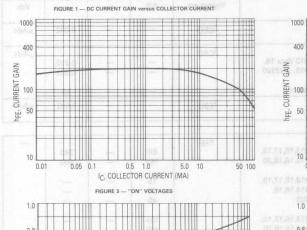
Characteristic		Syr	nbol	Min	Тур	Max	Unit
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 140 kHz)		Co	obo	_	4.0	6.0	pF
Input Impedance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)		2912813	ib	25	28	32	ohms
Output Admittance (I _C = 1.0 mAdc, V _{CB} = 5.0 Vdc, f = 1.0 kHz)		a result h	ob lades	a —	- 81	1.0	μmhos
Noise Figure (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 k Ω , f = 1.0 kHz, BW = 200 Hz)	2N2914,1 2N2913,1	45	OBO V	=	2.0	3.0	dB noroshe
$(I_C = 10 \mu Adc, V_{CE} = 5.0 Vdc, R_S = 10 kΩ,$ f = 10 Hz to 15.7 kHz, BW = 10 kHz)	2N2914,1 2N2913,1	One Die	25	_	2.0 3.0	3.0 4.0) rospetto
MATCHING CHARACTERISTICS	Wm		l dd		F100	e Discipate	otal David

DC Current Gain Ratio(2) (IC = 100 µAdc, VCF = 5.0 Vdc)	2N2917.18.	hFE1/hFE2	0.8		1.0	Derene .
The parties, the parties of the part	2N2915,16,19,20	dS.	0.9	_ no	1.0	veO liste?
Base-Emitter Voltage Differential (IC = 10 μAdc to 1.0 mAdc, VCE = 5.0 Vdc)	2N2917,18,	VBE1-VBE2			10	mVdc
MOJENS MARK	2N2915,16,19,20	gia ^T d	-	noiteaut e	5.0	Sperating Tempera
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N2917,18, 2N2915,16,19,20	25°C unless other	AD SON	ACTERIST	5.0 3.0	ELECTE
Base-Emitter Voltage Differential Change Due	to Temperature	Δ(V _{BE1} -V _{BE2})	in instante	0		mVdc
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc,$					MCTERIST	NAME OF THE
$T_A = -55^{\circ}\text{C to} + 25^{\circ}\text{C}$	2N2917,18, 2N2915,16,19,20	2N(2913)	age	kdown Valt = 0)	1.6 0.8	i ollector i (lig = 10
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc,$	2N2917,18	2N2919,	_		2.0	
$T_A = +25^{\circ}C \text{ to } +125^{\circ}C)$	2N2915,16,19,20		- 9	ps/loV-nwo	1.0	-rotosile.

1000 400

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) The lowest hee reading is taken as hee1 for this ratio.



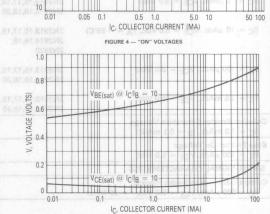
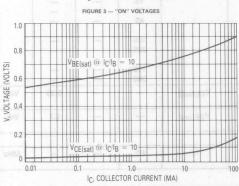


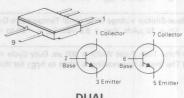
FIGURE 2 — DC CURRENT GAIN versus COLLECTOR CURRENT



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

2N3043 thru 2N3045 2N3048

CASE 610A-04, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	45		Vdc
Collector-Base Voltage	VCBO	45		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	IC	30		mAdc
		One Die	Both Die	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	250 1.67	350 2.33	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.7 4.67	1.4 9.33	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.) Characteristic Symbol Min Max Unit OFF CHARACTERISTICS Collector-Emitter Breakdown Voltage(1) 45 V(BR)CEO Vdc $(I_C = 10 \text{ mAdc}, I_B = 0)$ Emitter-Base Breakdown Voltage 5.0 Vdc V(BR)EBO _ $(I_E = 10 \ \mu Adc, I_C = 0)$ Collector Cutoff Current ІСВО μAdc (V_{CB} = 45 Vdc, I_E = 0) (V_{CB} = 45 Vdc, I_E = 0, T_A = +150°C) 0.010 10 0.010 **Emitter Cutoff Current** IEBO μAdc $(V_{EB} = 4.0 \text{ Vdc}, I_{C} = 0)$ ON CHARACTERISTICS DC Current Gain(1) hFE 2N3043, 2N3044, 2N3045 100 300 $(I_C = 10 \mu Adc, V_{CE} = 5.0 Vdc)$ 2N3048 50 200 $(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ 2N3043, 2N3044, 2N3045 130 2N3048 65 Collector-Emitter Saturation Voltage 1.0 Vdc VCE(sat) $(I_C = 10 \text{ mAdc}, I_B = 0.5 \text{ mAdc})$ Base-Emitter On Voltage VBE 0.6 0.8 Vdc $(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 20 MHz)		fT	30		MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)		C _{obo}		8.0	pF
Input Impedance (IC = 1.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz)	2N3043, 2N3044, 2N3045 2N3048	h _{ie}	3.2k 1.6k	19k 13k	Ohms
Small-Signal Current Gain (IC = 1.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz)	2N3043, 2N3044, 2N3045 2N3048	h _{fe}	130 65	600 400	-
Output Admittance (IC = 1.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 kHz)		h _{oe}	=	100 70	μmhos
Noise Figure (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 kohms, Ba	andwidth = 10 Hz to 15.7 kHz)	NF		5.0	dB

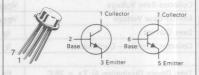
Characteristic		Symbol	Min	Max	Unit
MATCHING CHARACTERISTICS					
DC Current Gain Ratio(2) (IC = 10 μ Adc, VCE = 5.0 Vdc)	2N3043 2N3044	hFE1/hFE2	0.9	1.0 1.0	_
Base-Emitter Voltage Differential (IC = 10 μ Adc, VCE = 5.0 Vdc)	2N3043 2N3044	VBE1-VBE2	s 	5.0 10	mVdc
Base-Emitter Voltage Differential Temperature Gradiei (IC = 10 μ Adc, VCE = 5.0 Vdc, TA = -55 to $+125$		$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_{A}}$	= 01	10 20	μV/°C

(1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.
(2) The lowest hFE reading is taken as hFE1 for this test.

MAXIMUM RATINGS				
Rating	Symbol	Va Va	lue	Unit
Collector-Emitter Voltage	VCEO	36V 1	5 0.8	Vdc
Collector-Emitter Voltage	VCER	oli Am 2	20 081	Vdc
Collector-Base Voltage	VCBO	abAm 4	10 006	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
	Car I	One Die	Both Die	004
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.3 1.72	0.4 2.28	Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.75 4.3	1.5 8.55	Watts mW/°0
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	0 +200	°C

2N3425

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTORS

NPN SILICON

Refer to MD2369,A,B for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

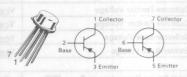
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			consusance	ARANO E
Collector-Emitter Breakdown Voltage(1) (I _C = 30 mAdc, R _{BE} ≤ 10 ohms)	VCER(sus)	20	skolasva vatti	Vdc
Collector-Emitter Sustaining Voltage(1) (I _C = 10 mAdc, I _B = 0)	VCEO(sus)	15	D = gi obA	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	40	e Bruidow	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	_ 3 _ab&m	Vdc
Collector Cutoff Current (VCE = 20 Vdc, VEB(off) = 0.25 Vdc, TA = 125°C)	CEX	voltage	15	μAdc
Collector Cutoff Current $\{V_{CB} = 20 \text{ Vdc}, I_E = 0\}$ $\{V_{CB} = 20 \text{ VDc}, I_E = 0, T_A = 150^{\circ}\text{C}\}$	ІСВО	_	0.025 15	μAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, IC = 0)	IEBO	7A = 180 C	0.2	μAdc
ON CHARACTERISTICS			frentu0 ?	om2 tant
DC Current Gain (I _C = 0.5 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc, T _A = -55°C)	hFE	12 30 12	120	V <u>ps</u> = 3 VCHARAL
Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$) ($I_C = 7.0 \text{ mAdc}$, $I_B = 0.7 \text{ mAdc}$, $T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$)	VCE(sat)	5.0 Vdc) 5.0 Vd c) 5.0 Vd c)	0.4 0.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 10$ mAdc, $I_B = 1.0$ mAdc) ($I_C = 7.0$ mAdc, $I_B = 0.7$ mAdc, $T_A = -55^{\circ}C$)	V _{BE} (sat)	0.7 0.8	0.85 0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS		fatiAm d	X = gf .obAi	g = 50 g
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	300	Saturation V	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 140 kHz)	Cobo	190AIRE 6	6.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 140 kHz)	Cibo	001109/101	9.0	pF
Small-Signal Current Gain (I _C = 10 mAdc, V _{CE} = 1.0 Vdc, f = 1.0 kHz)	hfe	20	Harring States	O. C. of Al
Real Part of Input Impedance (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 300 MHz)	Re(hie)	20 Vds, F	50 A	Ohms
SWITCHING CHARACTERISTICS			annano	tout Capa
Storage Time (I _C = 10 mAdc, I _{B1} = 10 mAdc, I _{B2} = 10 mAdc)	t _S	HIM U.I. = 1	40	ns
Turn-On Time (V _{CC} = 3.0 Vdc , V _{EB(off)} = 2.0 Vdc , I _C = 10 mAdc , I _{B1} = 3.0 mAdc)	ton	HEST D. E. = 1.	50	ns
Turn-Off Time {V _{CC} = 3.0 Vdc, I _C = 10 mAdc, I _{B1} = 3.0 mAdc, I _{B2} = 1.0 mAdc)	toff	= 1,55V 01	90	ns
) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 1.0%.	- (\$H9.0LT	- 1 30V DT	NAGO, VOE -	NULL SES

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.0%.

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	45		Vdc
Collector-Base Voltage	VCBO	rint. 4	5	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Base Current	IB	aby 1	00	mAdc
Collector Current — Continuous	Continuous IC 300		mAdc	
3 frotter 5 Leader		One Die	Both Die	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	400 2.29	500 2.86	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.85 4.85	1.4 8.0	Watt mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C
Collector ₁ to Collector ₂ Voltage Voltage rating any lead to case	VC1 VC2		200 200	Vdc Vdc

2N3726 2N3727

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

PNP SILICON

Refer to MD2905,A for graphs.

Shall stuff trible Ch	naracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					H FBIHS LUP	MARIN TR
Collector-Emitter Breakdown Voltage(1 (I _C = 10 mAdc, I _B = 0)	VOSOteus) (oAdr. Rgg 4 10 dkms) nAdc. Ig = 0)	V(BR)CEO	45	mater Bust	Vdc
Collector-Base Breakdown Voltage (IC = 0.01 mAdc, IE = 0)	V(ab)CSQ	10 = gf :	V(BR)CBO	45	nes <u>Pr</u> eskd s Brankder	Vdc
Emitter-Base Breakdown Voltage (IE = 0.01 mAdc, IC = 0)	X30	= 0.25 Vdc, TA = 125°C)	V(BR)EBO	5.0	emu U lleh.	Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0)	080	(3°68' - A	ICBO	= 80V) A = 80V)	10	nAdc
(V _{CB} = 30 Vdc, I _E = 0, T _A = 150°C	1203					μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	bye		IEBO	bAm 8.0 =	0.1	μAdc
ON CHARACTERISTICS			(abV 0.1 = 30V	shAm 07 =	2/	
DC Current Gain ($I_C = 0.01 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) ($I_C = 50 \text{ mAdc}$, $V_{CE} = 5.0 \text{ Vdc}$) (1)			hFE ep	80 120 135 115	350	0.0
Collector-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 2.5 mAdc)		g = 0.7 mAdc, T _A = -58°C1	VCE(sat)	TERRITOR	0.25	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 50 mAdc, I _B = 2.5 mAdc)	T	6. VCE = 10 Vdc, F = 100 MHz)	VBE(sat)	oar t l ibbo	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	000		1. 1. 01. 16	1/30	M sometime	200
Current-Gain — Bandwidth Product(2) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = (I _C = 50 mAdc, V _{CF} = 20 Vdc, f =		1,0 Vdc; f = 1,0 kHz) = 10 Vdc, f = 300 kHz)	10 mAde. Ves	60	600	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 1.0 MHz			C _{obo}	SOFT-HETT	8.0	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MH	z)		Cibo	gAm <u>-01</u> =	30 4	pF
Input Impedance (IC = 1.0 mAdc, V_{CE} = 10 Vdc, f =	1.0 kHz)	(dp. = 3.0 mAde)	tim 01 hie 30V	3(off) - 2d	11.5	kohm
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f =	1.0 kHz)	tobAre 0.1 = ggt	hre 191	= 10_erAde	1500	X 10-
Small-Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f =	1.0 kHz)		h _{fe}	135	420	-

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{oe}	-	80	μmhos
Noise Figure (I _C = 30 μ Adc, V _{CE} = 5.0 Vdc, R _S = 10 kohms, f = 1.0 kHz, B.W. = 200 Hz)	NF	_	4.0	dB

MATCHING CHARACTERISTICS						
DC Current Gain Ratio(3) (I _C = 0.1 mAdc to 1.0 mAdc, V _{CE} = 5.0 Vdc)	Total Control		hFE1/hFE2	0.9	1.0	LIMING (M
Base-Emitter Voltage Differential (Ic = 0.1 mAdc to 1.0 mAdc, VcF = 5.0 Vdc)	obV Vdc	2N3726	V _{BE1} -V _{BE2}	_ 10	5.0	mVdc
Minus 4	abV Vale	2N3727	deoV		2.5	B-notherloc
Base-Emitter Differential Change Due to Temperature			Δ(V _{BE1} -V _{BE2})		spalleV s	mVdc
$I_C = 0.1$ mAdc to 1.0 mAdc, $V_{CE} = 5.0$ Vdc, T_A		2N3726 2N3727	D ¹	evounitno	1.6 0.8	Al roburtos
	1.25%C += 1.125%C)	2012726			2.0	
$(I_C = 0.1 \text{ mAdc to } 1.0 \text{ mAdc, } V_{CE} = 5.0 \text{ Vdc, } T_A$	= +25°C to +125°C)	2N3726 2N3727	Q _d		1.0	E AT 8

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

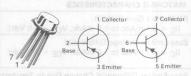
⁽²⁾ f_T is defined as the frequency at which $|h_{\mbox{\it fe}}|$ extrapolates to unity.

⁽³⁾ For purposes of this ratio, the lowest hee reading is taken as hee1.

2N3810,A 2N3811,A

CASE 654-07, STYLE 1

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	60		Vdc
Collector-Base Voltage		TXTEMS 60		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	Ic	50		mAdc
		One Die	Both Die	
Total Device Dissipation @ TA = 25°C	PD	500	600	mW
Derate above 25°C		2.86	3.43	mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C



2N3810, 2N3811 — JAN, JTX, JTXV AVAILABLE

DUAL AMPLIFIER TRANSISTOR

PNP SILICON

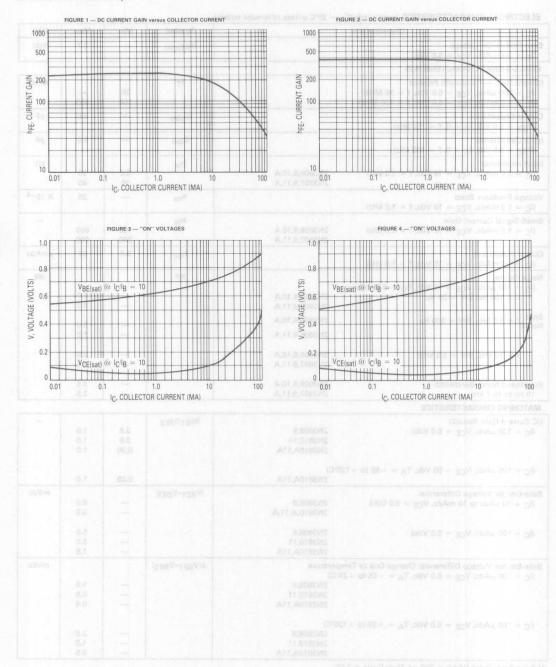
ELECTRICAL CHARACTERISTICS	(T_{Δ})	= 25°C unless otherwise noted.)
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Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)		V(BR)CEO	60	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)		V(BR)CBO	60	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	5.0	-	Vdc
Collector Cutoff Current $(V_{CB} = 50 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 50 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$		СВО	=	0.01 10	μAdo
Emitter Cutoff Current (VBE = 4.0 Vdc, I _C = 0)		IEBO	-	20	nAdd
ON CHARACTERISTICS					
DC Current Gain(1) (I _C = 1.0 μ Adc, V _{CE} = 5.0 Vdc)	2N3807,9,11,A	hFE	75	_	-
$(I_C = 10 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N3806,8,10,A 2N3807,9,11,A		100 225	=	
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N3806,8,10,A 2N3807,9,11,A		150 300	450 900	
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_A = -55^{\circ}C)$	2N3806,8,10,A 2N3807,9,11,A		75 150	=	
$(I_C = 500 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N3806,8,10,A 2N3807,9,11,A		150 300	450 900	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	2N3806,8,10,A 2N3807,9,11,A		150 300	450 900	
$(I_{C} = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	2N3806,8,10,A 2N3807,9,11,A		125 250	=	
Collector-Emitter Saturation Voltage(1) (IC = $100~\mu$ Adc, IB = $1.0~\mu$ A) (IC = $1.0~m$ Adc, IB = $100~\mu$ Adc)		VCE(sat)	Ξ	0.2 0.25	Vdd
Base-Emitter Saturation Voltage(1) (I _C = 100 μAdc, I _B = 10 μAdc) (I _C = 1.0 mAdc, I _B = 100 μAdc)		VBE(sat)	_	0.7 0.8	Vdo

Rasa-Emitter On Voltage		Voca	iviin	Nax 0.7	Unit
Base-Emitter On Voltage (I _C = 100 μAdc, V _{CE} = 5.0 Vdc)	058	VBE(on)		0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product		fT			MHz
$(I_C = 500 \ \mu Adc, V_{CE} = 5.0 \ Vdc, f = 30 \ MHz)$			30		
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 100 \text{ MHz})$	THE STATE OF SECTION SECTION		100	500	100
Output Capacitance		Cobo		4.0	pF
$(V_{CB} = 5.0 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$					9
Input Capacitance		Cibo		8.0	pF
$(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$					-
Input Impedance		h _{ie}		811127	kΩ
(I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	2N3806,8,10,A		3.0	30	10.0
	2N3807,9,11,A	AND TOTAL STATE OF	10	40	10.0
Voltage Feedback Ratio		h _{re}	_	25	X 10-
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$					
Small-Signal Current Gain		h _{fe}			_
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	2N3806,8,10,A	BEDAYJOY WO	150	600	
AND THE REPORT OF THE PERSON O	2N3807,9,11,A	THE RESERVE OF THE RE	300	900	305
Output Admittance		h _{oe}	5.0	60	μmho
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$		00			
Noise Figure		NF		WHI HE	dB
$(I_C = 100 \mu Adc, V_{CE} = 10 Vdc, R_G = 3.0 kohms$				Beal Mil	
f = 100 Hz, BW = 20 Hz	2N3806,8,10,A		11-14	7.0	-1- 8.0
	2N3807,9,11,A			4.0	
Spot f = 1.0 kHz, BW = 200 Hz	2N3806,8,10,A				I too
	2N3807,9,11,A			3.0 1.5	- NV 5
	2143607,9,11,A		TT F	1.5	
f = 10 kHz, BW = 2.0 kHz)	2N3806,8,10,A	North House and the second	+111	2.5	- 150
	2N3807,9,11,A		11 = <u>al</u> 5 is	1.5	
					Ha
Broadband Noise Bandwidth	2N3806,8,10,A	1.0	_	3.5	10.0
10 Hz to 15.7 kHz	2N3807,9,11,A	CALL CLIMBERS I MAD	DRLIM AL	2.5	
MATCHING CHARACTERISTICS					
DC Current Gain Ratio(2)		hFE1/hFE2			-
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	2N3808,9		8.0	1.0	
	2N3810,11		0.9	1.0	
	2N3810A,11A		0.95	1.0	
$(I_C = 100 \ \mu Adc, V_{CF} = 50 \ Vdc, T_A = -55 \ to + 12$	25°C)				1 1
THE TOTAL MASS, THE SECOND THE SE	2N3810A,11A		0.85	1.0	
Base-Emitter Voltage Differential		V _{BE1} -V _{BE2}			mVdd
(I _C = 10 μ Adc to 10 mAdc, V _{CE} = 5.0 Vdc)	2N3808.9	I DEI DEZI		8.0	IIIVac
	2N3810,A,11,A		_	5.0	
(I _C = 100 μAdc, V _{CE} = 5.0 Vdc)	2N3808,9			5.0	
	2N3810,11			3.0	
	2N3810A,11A			1.5	
Base-Emitter Voltage Differential Change Due to Ten		Δ(V _{BE1} -V _{BE2})		P. 181	mVdd
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_A = -55 \ to + 25^{\circ}C)$				1.0	
	2N3808,9 2N3810,11			1.6	
	2N3810A,11A			0.8	1
				0.4	
$(I_C = 100 \mu Adc, V_{CE} = 5.0 Vdc, T_A = +25 to +1)$	25°C)	Will be with a little			
	2N3808,9		_	2.0	
	2N3810,11		_	1.0	1
	2N3810A,11A			0.5	

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%. (2) The lowest hFE reading is taken as hFE1 for this ratio.

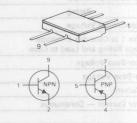




Rating	Symbol	Va	lue	Unit
Collector-Emitter Voltage	VCEO	40		Vdc
Collector 1 to Collector 2 Voltage Voltage Rating any Lead to Case	V _{C1C2}	± 120 000 ± ± 120		Vdc
Collector-Base Voltage	V _{CBO}	60		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	Ic	600		mAdc
		One Die	Both Die	3.000
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.25 0.35 1.67 2.34		Watt mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.7 4.67	1.4 9.34	Watts
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

2N3838

CASE 610A-04, STYLE 1



COMPLEMENTARY DUAL AMPLIFIER TRANSISTOR

NPN/PNP SILICON

	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	M loday8	obainsternade.			
Collector-Emitter Breakdow	vn Voltage(1) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	SOH SHEET	Vdc
Collector-Emitter Nonmatch (IC(on) = 600 mAdc, IB(o	hing Voltage on) = 120 mAdc, I _{B(off)} = 0)	VCEO(NL)†	40	nter Breskit Ado, Ig = 0	Vdc
Collector-Base Breakdown	Voltage ($I_C = 10 \mu Adc, I_E = 0$)	V(BR)CBO	60	se Greakdow	Vdc
Emitter-Base Breakdown V	oltage ($I_E = 10 \mu Adc$, $I_C = 0$)	V(BR)EBO	5.0		Vdc
Base Cutoff Current (VCE	= 50 Vdc, VBE(off) = 0.5 Vdc)	IBEV		10	nAdc
	VCE = 50 Vdc, VBE(off) = 0.5 Vdc) VCE = 50 Vdc, VBE(off) = 0.5 Vdc, T _A = 150°C)	ICEV	=	0.01	μAdc
Emitter Cutoff Current (V	BE = 3.0 Vdc, I _C = 0)	I _{EBO}	IT + = AT.	10	nAdc
ON CHARACTERISTICS	- 063			if Current	Emitter Cure
DC Current Gain $(I_C = 0.1)$	1 mAdc, V _{CE} = 10 Vdc) 0 mAdc, V _{CE} = 10 Vdc)	hFE	35 50	TRAISTICS	ON CHARAC
($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}$)(1) ($I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}$)(1) ($I_C = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$)(1)			75 100 50	300	DC Current 0 10 = 0.01 10c = 0.01
Collector-Emitter Saturatio	n Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	V _{CE(sat)}	5.0 Vac)	0.4	Vdc
Base-Emitter Saturation Vo	oltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)	V _{BE} (sat)	0.85	1.3	Vdc
SMALL-SIGNAL CHARACT	TERISTICS TERISTICS	V			No = E0 m
Current-Gain — Bandwidth	Product ($I_C = 20 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 100 \text{ MHz}$)	fT	200	September 2	MHz
Output Capacitance (VCB	= 10 Vdc, IE = 0, f = 140 kHz)	Cobo	2.6 14 de)	8.0	08 - pF
Input Impedance (I _C = 1.	.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	hie	1.6	9.0	kohms
Small-Signal Current Gain	$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$	hfe	60	300	Dur e nt-Gain
Output Admittance (I _C =	1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	hoe	20 Vds, 1	50	μmho
Noise Figure (I _C = 100 µAdc, V _{CE} = 10 Vdc, R _S = 1.0 kohm, f = 1.0 kHz)		NF	*****	8.0	dB
SWITCHING CHARACTERI	STICS	199			
Delay Time	(V _{CC} = 10 Vdc, V _{BE(off)} = 0 Vdc,	t _d	W 0.1- 1.0	10	ns
Rise Time	IC = 150 mAdc, IB1 = 15 mAdc)	t _r	_	40	ns
Storage Time	(V _{CC} = 10 Vdc, I _C = 150 mAdc,	ts	10 Was, f	250	ns
Fall Time	$I_{B1} = I_{B2} = 15 \text{ mAdc}$	tf	_	90	ns

 ⁽¹⁾ Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
 † The highest value of collector supply voltage that may be safely used with a resistive load switching circuit in which the collector current is 600 mAdc.

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	6	60	Vdc
Collector 1 to Collector 2 Voltage Voltage Rating and Lead to Case	V _{C1C2}	± 200 ± 200 021 ±		Vdc
Collector-Base Voltage	VCBO	60		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Base Current	I _B	100		mAdc
Collector Current — Continuous	I _C	300		mAdc
		One Die	Both Die	1 97%X
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	400 2.29	500 2.86	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.85 4.85	1.4 8.0	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

2N4016

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

O'85 - PNP SILICON O solved latel

Refer to MD2905,A for graphs.

ELECTRICAL	CHARACTERISTICS	$(T_{\Lambda} =$	25°C unless	otherwise noted.)

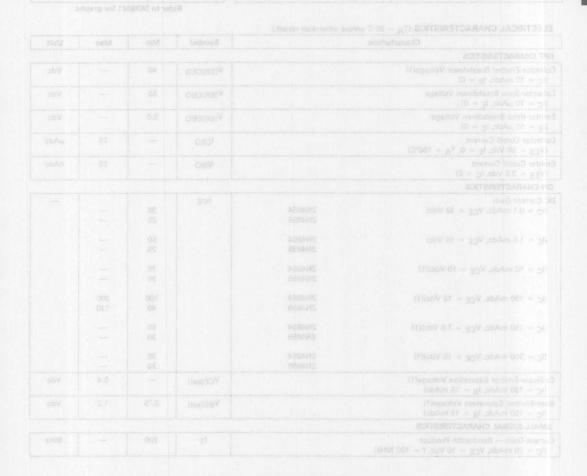
C	Symbol	Min	Max	Unit		
OFF CHARACTERISTICS		0 mAqc, ta = 0i				
Collector-Emitter Breakdown Voltage((I _C = 10 mAdc, I _B = 0)	NCED(NIL)	10 = 10	V(BR)CEO	60	oM nernma Am 003	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0) '	овр(яв)У	(0 = 3(.a)	V(BR)CBO	60	New Track	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	083(R8)* V38	0.5 Vda)	V(BR)EBO	5.0	off Current	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = `0)		A = 0.5 V(c) $A = 0.5 \text{ V(c)}$ $A = 150^{\circ}\text{C}$	ІСВО	= 30 <u>A)</u> = 30A) sue	. 10	nAdc.
$(V_{CB} = 50 \text{ Vdc}, I_{E} = 0, T_{A} = +150)$	o°C)		10 - 31 opy 01	(Bely) I	10	μAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0)			IEBO	- 80	0.1 0.4	μAdc
ON CHARACTERISTICS	299		by or a gov.a	bAm 0.1 =	nl)	
DC Current Gain (IC = 0.01 mAdc, VCE = 5.0 Vdc) (IC = 0.1 mAdc, VCE = 5.0 Vdc)		(1) (-147) (-177)	99V 01 hFE 33V 30 9V 01 = 33V 30 V 0.1 = 33V 30	80 120	(0) (4) (4)	_
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ $(I_C = 50 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})(1)$	(Isa) 30 ^V	0 mAda, (g = 15 mAda) Nda, ta = 18 mAda)	or 021 - 41 11	115	350	Collector
Collector-Emitter Saturation Voltage(1 (I _C = 50 mAdc, I _B = 2.5 mAdc))		VCE(sat)	NACTERIST	0.25	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 50 mAdc, V _{CE} = 2.5 Vdc)		Nac, $VCE = 10 \text{ Vac, } t = 100 \text{ MHz}$ T40 KHz).	V _{BE} (sat)	(ACS = 18)	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						and high
Current-Gain — Bandwidth Product(2 (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f =	100 MHz)	= 10 Vdc, $t = 1.0$ kHz) tdc, $t = 1.0$ kHz)		and the second second second second	600	MHz
Output Capacitance (VCB = 10 Vdc, I _F = 0, f = 1.0 MH	36	1.0 kHz)	Cobo	- 00	8.0	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 1.0 MH	Hz) b ¹	μη = 0 Vdc,	Cibo	33V)	25	pF
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f =	1.0 kHz)	15 nuAdo	h _{ie}	* 31	11.5 emi	kohms
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f =	1.0 kHz)	so c	BAm chre sal	= rgl-	15	X 10-4
Small-Signal Current Gain (IC = 1.0 mAdc, VCE = 10 Vdc, f =		et may be safely used with a resistiv	is eggs h _{fe} vlags	135	420	-

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic Output Admittance (IC = 1.0 mAdc, VCF = 10 Vdc, f = 1.0 kHz)			Symbol	Min	Max	Unit
			h _{oe}		80	μmhos
Noise Figure (I _C = 0.03 mAdc, V _{CE} = 5.0 Vdc, R _S = 10 kohms, f	NF	- :	4.0	dB		
MATCHING CHARACTERISTICS	711162	Obe	No miles			
DC Current Gain Ratio (I _C = 0.1 mAdc, V _{CE} = 5.0 Vdc)	56V	000.±	hFE1/hFE2	0.9	1.0	F voltarill
Base-Emitter Voltage Differential (IC = 0.1 to 1.0 mAdc, V _{CE} = 5.0 Vdc)	yde	2N4015 2N4016	VBE1-VBE2		5.0 2.5	mVdc
Base-Emitter Voltage Differential Gradient (IC = 0.1 to 1.0 mAdc, $V_{CE} = 5.0$ Vdc, $T_{A} = -55$ to	+ 25°C)	2N4015 2N4016	$\frac{\Delta(V_{\text{BE1}}-V_{\text{BE2}})}{\Delta T_{\text{A}}}$	rumuous m Ta =	1.6 0.8	mVdc
(I _C = 0.1 to 1.0 mAdc, V_{CE} = 5.0 Vdc, T_{A} = +25°C			07 2/8	_	2.0	ds atstate

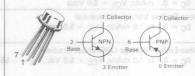
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.0%.

⁽²⁾ fT is defined as the frequency at which |hfe| extrapolates to unity.



2N4854

2N4854 — JAN, JTX, JTXV AVAILABLE CASE 654-07, STYLE 5



COMPLEMENTARY DUAL AMPLIFIER TRANSISTOR

NPN/PNP SILICON

Refer to MD6001 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value		Unit		
Collector-Emitter Voltage	VCEO	40		Vdc		
Collector 1 to Collector 2 Voltage Voltage Rating any Lead to Case	V _{C1C2}	± 200 ± 200		Vdc		
Collector-Base Voltage	VCBO	60		60 V		Vdc
Emitter-Base Voltage	VEBO	810 5.0		Vdc		
Collector Current — Continuous	a IC	600		mAdc		
0.1 T A	FA	One Die	Both Die	1355+		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 2.0	600	mW mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 6.67	2.0 13.33	Watts		
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		· · · · C		

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)		V(BR)CEO	40		Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V(BR)CBO	60		Vdc
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$		V(BR)EBO	5.0	-	Vdc
Collector Cutoff Current ($V_{CB} = 50 \text{ Vdc}, I_{E} = 0, T_{A} = 150^{\circ}\text{C}$)		ІСВО	I.T.	10	μAdc
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)		IEBO		10	nAdc
ON CHARACTERISTICS					
DC Current Gain $\{I_C = 0.1 \text{ mAdc, } V_{CE} = 10 \text{ Vdc}\}$	2N4854 2N4855	hFE	35 20		-
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	2N4854 2N4855		50 25	=	
$(i_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N4854 2N4855		75 35	Ξ	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N4854 2N4855		100 40	300 120	
$(I_C = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})(1)$	2N4854 2N4855		50 20	=	
$(I_C = 300 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})(1)$	2N4854 2N4855		35 20		
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)		V _{CE(sat)}		0.4	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc)		V _{BE} (sat)	0.75	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)		fT	200		MHz

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}C$ unless otherwise noted.)

	Characteristic				Symbol	Min	Max	Unit
Collector-Base Capacitano (V _{CB} = 10 Vdc, I _E = 0,				A V	Ccb	-	8.0	pF
Input Impedance (IC = 1.0 mAdc, VCF =	10 Vdc, f = 1.0 kHz)	obV.	2N4854	±2 ±2	hie	1.5	9.0	kohms
repeled 1			2N4855		Vego	0.75	4.5	Sallector-Bus
Small-Signal Current Gair	1 TOUR				os h _{fe}		Voltage	east as mi
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$			2N4854 2N4855		gl	60 30	300 150	issa Current
Output Admittance (IC = 1.0 mAdc, VCF = 10 Vdc, f = 1.0 kHz)		SDAM	2N4854	Dire Dia	h _{oe}	2000	50	μmhos
146			2N4855		09 1	_	no 25 and	spiveO (sto)
	10 Vdc, R _S = 1.0 kohm,	f = 1.0 kH	1z) 000	250	NF	-	8.0	dB
SWITCHING CHARACTER	RISTICS	30000	1 (A.A.	0.0		anne	30 - 9 43 01	Wetst Cen
Delay Time	(VCC = 30 Vdc, VBF(off) = 0.5 Vo	dc,		ag t _d	Te Ta 2810	20	ns
Rise Time	I _C = 150 mAdc, I _{B1} =				t _r	_	40	ns
Storage Time	(Vcc = 30 Vdc, Ic = 150		11,42	68.8	t _S		280	ns
Fall Time	$I_{B1} = I_{B2} = 15 \text{ mAdc}$	32 = 15 mAdc)			tf	- neida	70	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

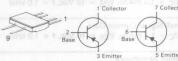
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MAYIMI IM DATINGS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	4	10	Vdc
Collector 1 to Collector 2 Voltage Voltage Rating and Lead to Case	VC1C2	± 200 ± 200		Vdc
Collector-Base Voltage	VCBO	5	0 228545	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Base Current	IB	10		mAdc
Collector Current — Continuous	IC	50		mAdc
2011102	300	One Die	Both Die	
Total Device Dissipation @ TA = 25°C — Ceramic Metal Can Detate above 25°C — Ceramic Metal Can	PD	250 500 1.5 2.9	350 600 2.0 3.4	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C Metal Can	PD	1.2 6.85	2.0 11.42	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	0 +200	°C



CASE 654-07, STYLE 1



2N4941 CASE 610A-04, STYLE 1



DUAL AMPLIFIER TRANSISTOR

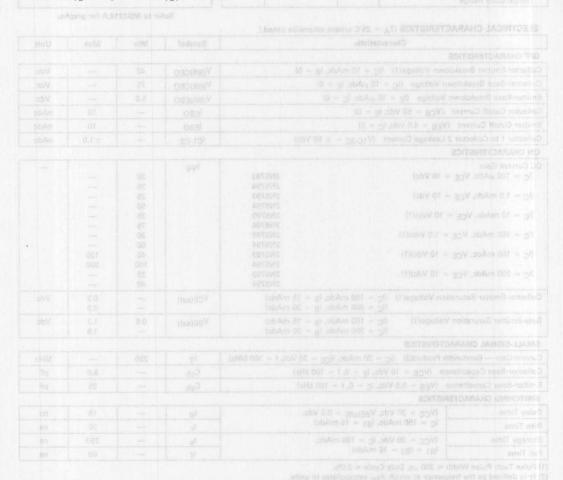
PNP SILICON

Refer to MD3250,A for graphs.

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	-	Vdc	
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	50	-	Vdc	
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)	V(BR)EBO	5.0	-	Vdc	
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0)	ICBO	-	20	nAdc	
Emitter Cutoff Current (V _{BE} = 3.0 Vdc, I _C = 0)	IEBO	-	20	nAdc	
ON CHARACTERISTICS					
DC Current Gain (I _C = 100 μAdc, V _{CE} = 10 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	hFE	40 50 50	200 250 250		
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 Mhz)	fT	300	900	MHz	
Output Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 140 \text{ kHz}$) Emitter Guarded	C _{cb}	-	5.0	pF	
Input Impedance (IBE = 0.5 Vdc, IC = 0, f = 140 kHz) Collector Guarded	C _{eb}	-	10	pF	
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{ie}	1.0	10	kΩ	
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{re}	-	10	X 10-4	
Small-Signal Current Gain ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	hfe	50		-	
Output Admittance ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h _{oe}	5.0	50	μmhos	
Noise Figure (I _C = 100 μ Adc, V _{CE} = 10 Vdc, R _S = 3.0 k Ω , f = 10 Hz to 15.7 kHz)	NF	6-1	4.0	dB	

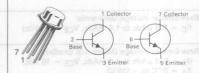
		Symbol	141111	IVIGA	Unit
	2N4937, 2N4941 2N4938	h _{FE1} /h _{FE2}	0.9 0.8	1.0	- MAXAM
		Symbol	9/	WAR .	
	2N4937, 2N4941	Vosc	0.85	1.0	a rosse lo
Valu	2N4938	Messe	0.7	1.0	B-roton lo
	0.6	VBE1-VBE2		e Voltage	mVdc
	2N4937, 2N4941 2N4938	31	ntinudus		O rotas lo
	2N4937, 2N4941	$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_{A}}$		1.0	mVdc
	2N4938	28°C PD	= A T N n		
	2N4937, 2N4941 2N4938	25°C Pg	= <u>gT</u> m a	0.8	olal David Letate al
	Vdsc Wdsc mAde Wssc O'Wests	2N4938 2N4937, 2N4941 2N4938 2N4937, 2N4941 2N4938 2N4937, 2N4941 2N4938 2N4937, 2N4941	2N4937, 2N4941 2N4938 2N4937, 2N4941 2N4938 2N4937, 2N4941 2N4938 2N4937, 2N4941 2N4938 2N4937, 2N4941 2N4938	2N4937, 2N4941 0.85 2N4937, 2N4941 0.85 2N4937, 2N4941 0.85 2N4937, 2N4941 VBE1-VBE2	2N4937, 2N4941 0.8 1.0 2N4937, 2N4941 0.85 1.0 2N4937, 2N4941 0.7 1.0 2N4938 VBE1-VBE2

⁽¹⁾ The lowest hee reading is taken as hee1 for this ratio.



2N5794

JAN, JTX, JTXV AVAILABLE CASE 654-07, STYLE 1



DUAL TRANSISTOR

NPN SILICON

Refer to MD2218,A for graphs.

MAXIMUM RATINGS

Rating		Symbol	V	alue	Unit
Collector-Emitter Voltage		VCEO	1969/4	40	Vdc
Collector-Base Voltage		VCBO		75	Vdc
Emitter-Base Voltage	CBE7-	VEBO		6.0	Vdc
Collector Current — Continuous		IC	600		mAdc
1.0 mVde	y-Veez AT	ggV)A	One Die	Both Die Equal Power	
Total Device Dissipation @ T _A = 25 Derate above 25°C	5°C	PD	500 2.9	600 3.4	mW mW/°C
Total Device Dissipation @ T _C = 25 Derate above 25°C	5°C	PD	1.2 6.9	2.0 11.43	Watts mW/°C
Operating and Storage Junction Temperature Range		T _J , T _{stg}	- 65	to +200	°C

ELECTRICAL CHARACTERISTICS ($T_A = 25$ °C unless otherwise noted.)

Chara	cteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1)	(I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	_	Vdc
Collector-Base Breakdown Voltage (IC =	10 μAdc, I _E = 0)	V(BR)CBO	75	_	Vdc
Emitter-Base Breakdown Voltage (IE = 1	0 μAdc, I _C = 0)	V(BR)EBO	6.0		Vdc
Collector Cutoff Current (VCB = 50 Vdc,	IE = 0)	ІСВО	_	10	nAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I	C = 0	IEBO	-	10	nAdc
Collector 1 to Collector 2 Leakage Current	$(V_{1C-2C} = \pm 50 \text{ Vdc})$	IC1-C2		± 1.0	nAdc
ON CHARACTERISTICS				11417	
DC Current Gain (IC = 100 μ Adc, VCE = 10 Vdc) (IC = 1.0 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc)(1) (IC = 150 mAdc, VCE = 1.0 Vdc)(1) (IC = 150 mAdc, VCE = 10 Vdc)(1) (IC = 300 mAdc, VCE = 10 Vdc)(1)	2N5793 2N5794 2N5793 2N5794 2N5793 2N5794 2N5793 2N5794 2N5793 2N5794 2N5793 2N5794	hFE	20 35 25 50 35 75 20 50 40 100 25 40	120 300	
Collector-Emitter Saturation Voltage(1) ($I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$ $I_C = 300 \text{ mAdc}, I_B = 30 \text{ mAdc})$	VCE(sat)	=	0.3	Vdc
	$I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$) $I_C = 300 \text{ mAdc}$, $I_B = 30 \text{ mAdc}$)	V _{BE(sat)}	0.6	1.2 1.8	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (IC	$=$ 20 mAdc, V_{CE} $=$ 20 Vdc, f $=$ 100 MHz)	fŢ	250	_	MHz
Collector-Base Capacitance (V _{CB} = 10 V	/dc, IE = 0, f = 100 kHz)	C _{cb}	-	8.0	pF
Emitter-Base Capacitance (V _{EB} = 0.5 Vo	dc, I _C = 0, f = 100 kHz)	Ceb	_	25	pF
SWITCHING CHARACTERISTICS					
	c, V _{BE(off)} = 0.5 Vdc,	td	_	15	ns
Rise Time I _C = 150 mAc	dc, I _{B1} = 15 mAdc)	t _r	_	30	ns
	c, I _C = 150 mAdc,	t _S	-	250	ns
Fall Time IB1 = IB2 = 1	15 mAdc)	tf	_	60	ns

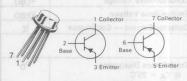
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(2) fT is defined as the frequency at which |hfe| extrapolates to unity.

MAXIMUM KATINGS				
Rating	Symbol	V	alue	Unit
Collector-Emitter Voltage	VCEO	ODV	60	Vdc
Collector-Base Voltage	VCBO	obl/	60	Vdc
Emitter-Base Voltage	VEBO	apiy	5.0	Vdc
Collector Current — Continuous	Ic		600	mAdc
to the state of th		One Die	Both Die Equal Power	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	500 2.9	600 3.4	mW mW/°C
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 6.9	2.0 11.43	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65	to +200	°C -

2N5795 2N5796

JAN, JTX, JTXV AVAILABLE **CASE 654-07, STYLE 1**



DUAL TRANSISTOR

PNP SILICON

Refer to MD2904,A for graphs.

ELECTRICAL	CHARACTERISTICS	$(T_{\Lambda} =$	25°C unless	otherwise noted.)	

	Char	acteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	S	1001031		end ibid	THE RESERVE OF THE PARTY OF THE		
Collector-Emitter Break	down Voltage(1)	(IC = 10 mAdc, Ig	3 = 0)	V(BR)CEO	60	United Contests	Vdc
Collector-Base Breakdov	wn Voltage (IC	= 10 μ Adc, I _E = 0)	V(BR)CBO	60	STREET, SOURCE	Vdc
Emitter-Base Breakdow	n Voltage (IE =	10 μ Adc, I _C = 0)		V(BR)EBO	5.0	-	Vdc
Collector Cutoff Current	(V _{CB} = 50 Vdd	c, IE = 0)		ІСВО		20	nAdc
Emitter Cutoff Current	(VBE = 3.0 Vdc,	I _C = 0)	weical cripted circuit bear	IEBO	e so lve h od	100	nAdc
Collector 1 to Collector	2 Leakage Currer			IC1-C2	_	± 1.0	nAdc
ON CHARACTERISTICS		10 20	Liberon palvirento aso		азитыявт	AL CHARAC	E GTRICK
DC Current Gain	nite	Symbol		hee	10		
$(I_C = 100 \mu Adc, V_{CE})$	= 10 Vdc)		2N5795		40	CTERISTICS	
			2N5796	1	75	_	
$(I_C = 1.0 \text{ mAdc}, V_{CE})$	= 10 Vdc)		2N5795		40	itier <u>Bre</u> akde Adc. <u>In</u> = 0	
	-		2N5796		100		
$(I_C = 10 \text{ mAdc}, V_{CE})$	= 10 Vdc)(1)		2N5795		40	inter lin oskdo	
	4 0 1/ 1 1/41		2N5796		100	= 38 V ob Au	
(I _C = 150 mAdc, V _{CE}	= 1.0 Vdc(1)		2N5795		20	e Breakdown	
			2N5796		50	120 hA	
(I _C = 150 mAdc, V _{CE}	= 10 Vdc(1)		2N5795		40		
			2N5796		100	300	
$(I_C = 500 \text{ mAdc}, V_{CE})$	= 10 Vdc(1)		2N5795		40	IO = al ,abA	
1.7 aAde		mani	2N5796		50	off Current	ador Cur
Collector-Emitter Satura	ation Voltage(1)	(IC = 150 mAdc, I	B = 15 mAdc)	VCE(sat)		0.4	Vdc
		$(I_C = 500 \text{ mAdc}, I$	B = 50 mAdc		_	1.6	
Base-Emitter Saturation	Voltage(1)	(I _C = 150 mAdc, I	p = 15 mAdc)	V _{BE(sat)}		1.3	Vdc
Dado Elinitor Datardion		(IC = 500 mAdc, I		· DE(Sdt)	_	2.6	*40
SMALL-SIGNAL CHARA			5				17.74.57
Current-Gain — Bandwid	dth Product(2) (I	c = 50 mAdc, VCF	= 20 Vdc, f = 100 MHz)	fT	200	_	MHz
Collector-Base Capacita				C _{cb}		8.0	pF
Emitter-Base Capacitano				C _{eb}	_	30	pF
SWITCHING CHARACT	ERISTICS (See Fi	gure 1)					
Delay Time		$dc, V_{BE(off)} = 0.5$		td		12	ns
Rise Time	I _C = 150 mA	dc , $I_{B1} = 15 \text{ mAd}$	c)	t _r		35	ns
Storage Time		dc, I _C = 150 mAdd	3,	t _S	-	100	ns
Fall Time	I _{B1} = I _{B2} =	15 mAdc)		tf	_	40	ns

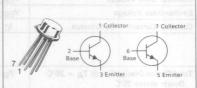
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ f_T is defined as the frequency at which $|h_{\mbox{\scriptsize fe}}|$ extrapolates to unity.

IVIAAIIVIOIVI RATIIVGS		_		
Rating	Symbol		Value	Unit
Collector-Emitter Voltage	VCEO	40		Vdc
Collector-Base Voltage	VCES	100	80	Vdc
Collector-Base Voltage	VCBO	at	80	Vdc
Emitter-Base Voltage	VEBO	1	6.0	Vdc
Collector Current — Continuous	IC	n/h	1.0	Adc
0 mmg (m) mmg		One Die	All Die Equal Power	anti
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	600 3.42	650 3.7	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	2.1	3.0 17.2	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 69	5 to +200	°C

2N6502

CASE 654-07, STYLE 1



DUAL SWITCHING TRANSISTOR

NPN SILICON

THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{ heta}$ JC	83.3	58.3	°C/W
Thermal Resistance, Junction to Ambient(1)	R_{θ} JA	292	270	°C/W
VIENDERO 6.9 - Vdc	Adc. 1c + 0)	Junction to Ambient	Junction to Case	es n.S. Happier
Coupling Factor 080 080	10 =	85	40	ollector Cu

⁽¹⁾ $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	205785		10 Vde)	= agV .obAu	001 = 011
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	2N6795	V(BR)CEO	40	- 30V IbbAn	Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)		V _(BR) CES	(1) 80 / 01	= SON SBA	Vdc
Collector-Base Breakdown Voltage $(I_C = 100 \ \mu Adc, I_E = 0)$	2NS/98 2NS/96	V(BR)CBO	80	JOV_JONAM	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	2N5726 2N5785	V(BR)EBO	6.0	any obam	Vdc
Collector Cutoff Current	21/6780	Ісво	_	1.7	μAdc
(V _{CB} = 40 Vdc, I _E = 0)	to mAgo)	Vin 081 - 58	Con Voltage(1)	tarufel notri	Tellestor-En

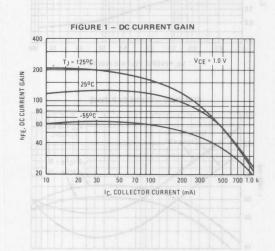
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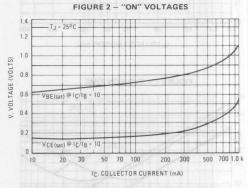
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
Emitter Cutoff Current (VBE = 4.0 Vdc, IC = 0)	IEBO		1.0	μAdc
ON CHARACTERISTICS		All		1 - 4
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 2.0 Vdc) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc)	hFE	50 30 10	150 — —	- 46 - 46 TE
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 10 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	VCE(sat)	Then to	0.3 0.5	Vdc
Base-Emitter Saturation Voltage (IC = 500 mAdc, IB = 50 mAdc)	V _{BE} (sat)	0.8	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS	(Am), T3(3)	AND REAL TO		History
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	250	-	MHz
Collector-Base Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{cb}	-	10	pF
Emitter-Base Capacitance $(V_{BE} = 0.5 \text{ Vdc}, I_C = 0, f = 100 \text{ kHz})$	C _{eb}		65	pF
SWITCHING CHARACTERISTICS				
Turn-On Time ($V_{CC} = 30 \text{ Vdc}$, $V_{BE} = 3.8 \text{ Vdc}$, $I_{C} = 500 \text{ mAdc}$, $I_{B1} = 50 \text{ mAdc}$)	ton	-	35	ns
Turn-Off Time (V _{CC} = 30 Vdc, I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAdc)	toff	AD MEAN	60	ns

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

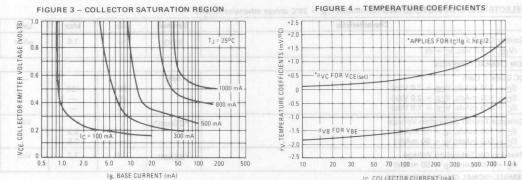
TYPICAL DC CHARACTERISTICS

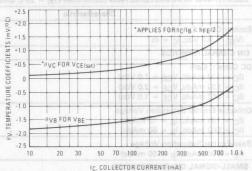




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TYPICAL DYNAMIC CHARACTERISTICS

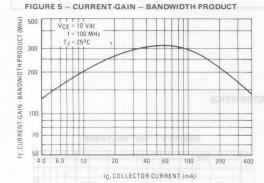


FIGURE 6 - CAPACITANCE

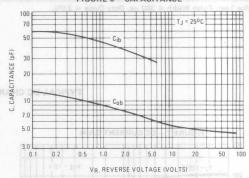


FIGURE 7 - TURN-ON TIME

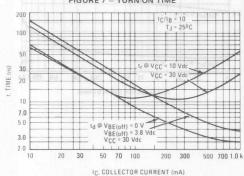
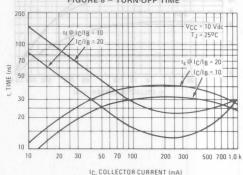
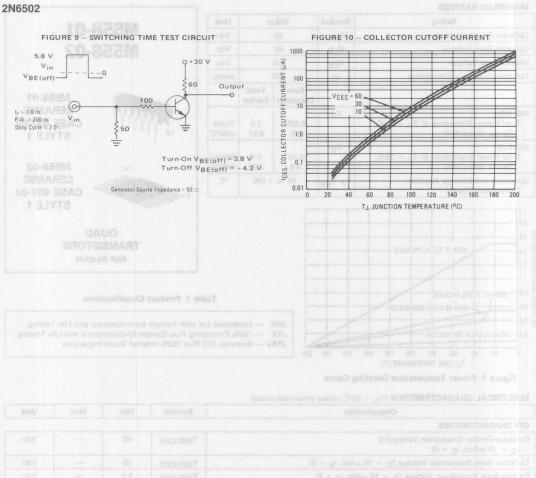


FIGURE 8 - TURN-OFF TIME







		Unit
o lector-civiltar Breakdown Voltage(1) (1c = 10 mAdc, 1g = 0)		

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	60	60	
Collector-Base Voltage	VCB	60	-Ere	Vdc
Emitter-Base Voltage	VEB	5.0	5.0	
Collector Current — Continuous	Ic	I _C 600		mAdc
	38 = 82 V	Each Transistor	Total Device	O-c-i
M558-01 Total Power Dissipation @ T _A = 25°C Derate above 25°C	PD	0.525 3.0	1.5 8.57	Watts mW/°C
M558-02 Total Power Dissipation @ T _A = 25°C Derate above 25°C	PD	0.14 0.8	0.4	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +200		°C

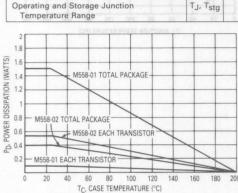




Table 1. Product Classifications

JAN — Controlled Lot with Sample Environmental and Life Testing JTX — 100% Processing Plus Sample Environmental and Life Testing JTXV — Same as JTX Plus 100% Internal Visual Inspection

Figure 1. Power Temperature Derating Curve

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO	60		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	60	1 9 E	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	5.0		Vdc
Collector Cutoff Current (IE = 0, V _{CB} = 60 Vdc) (IE = 0, V _{CB} = 60 V, T_A = 150°C)	ІСВО	Ξ	10 10	nAdc μA
Emitter Cutoff Current (I _C = 0, V _{CB} = 4.0 Vdc)	IEBO		10	nAdc
ON CHARACTERISTICS				
DC Current Gain(1) (IC = 0.1 mA, V _{CE} = 10 Vdc) (IC = 1.0 mA, V _{CE} = 10 Vdc) (IC = 10 mAdc, V _{CE} = 10 Vdc) (IC = 150 mAdc, V _{CE} = 10 Vdc) (IC = 500 mAdc, V _{CE} = 10 Vdc) (IC = 10 mA, V _{CE} = 10 Vdc)	hFE	75 100 100 100 50 50	450 — 300 —	
Collector-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc) (IC = 500 mAdc, IB = 50 mAdc)	VCE(sat)	=	0.4 1.6	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	VBE(sat)	0.6	1.3 2.6	Vdc
DYNAMIC CHARACTERISTICS				
Current-Gain — Bandwidth Product(1) (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	250	800	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo}		8.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MHz)	Cibo	_	30	pF

rum-on time			ton	shonau	45	ns
$(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc},$ $I_{C} = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc}) \text{ (Figure 2)}$		Endw Translator				
Turn-Off Time			toff	_	300	ns
(V _{CC} = 30 Vdc, I _C = 150 mAdc, I _{B1} = I _{B2} = 15 mAdc) (Figure 3)			3.6		ker Distripetion labova 25°C	

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle = 2.0%.

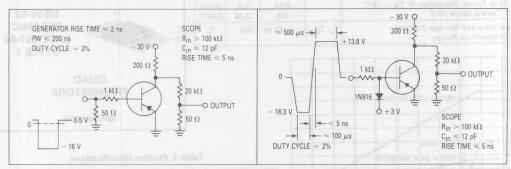


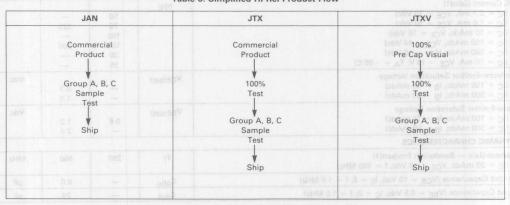
Figure 2. ton Test Circuit

Figure 3. toff Test Circuit

Table 2. JTX, JTXV 100% Processing Steps

	JTX	JTXV
Internal Visual (Mil-Std-750, Method 2072)	miersu <u>s</u> umneum	100%
High Temperature Storage (Mil-Std-750, Method 1032)	100%	100%
Thermal Shock (Mil-Std-750, Method 1051 Cond. F*)	100%	100%
Constant Acceleration (Mil-Std-750, Method 2006, 20 KG ^s , Y ₁)	100%	100%
Hermetic Seal (Fine + Gross Leak) (Mil-Std-750, Method 1071, Cond. G or H)**	100%	100%
READ Electrical Parameters (Group A)	100%	100%
High Temperature Reverse Bias (Mil-Std-750, Method 1039, Cond. A)	100%	100%
READ Electrical Parameters (Group A)	100%	100%
Power Burn-In (Mil-Std-750, Method 1039, Cond. B)	100%	100%
READ Electrical Parameters (Group A)	100%	100%

Table 3. Simplified Hi-Rel Product Flow



 $^{^*}T(LOW) = -55^{\circ}C$ **Cond. G, Fine Leak = 1 x 10 7 ATM. CC/sec.

MAXIMI IM BATINGS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	50	Vdc	
Collector-Base Voltage	VCB	75		Vdc
Emitter-Base Voltage	VEB	6.0		Vdc
Collector Current — Continuous	Ic	800		mAdc
		Each Transistor	Total Device	
M559-01 Total Power Dissipation @ Τ _Α = 25°C Derate above 25°C	PD	0.525 3.0	1.5 8.57	Watts mW/°C
M559-02 Total Power Dissipation @ TA = 25°C Derate above 25°C	PD	0.14 0.8	0.4 2.29	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	65 to	+ 200	°C

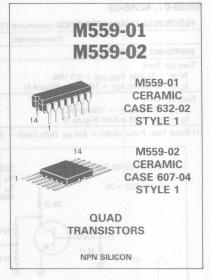


Table 1. Product Classifications

JAN — Controlled Lot with Sample Environmental and Life Testing JTX — 100% Processing Plus Sample Environmental and Life Testing JTXV — Same as JTX Plus 100% Internal Visual Inspection

Figure 1. Power Temperature Derating Curve

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	151 VOV.07 10	JUS EDITISM JU	- Diparter in	Separate de la composition della composition del	2.01
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, I _B = 0)			50	estrical Page	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE =	V(BR)CBO	75 sva	R enul ar dome	Vdc	
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$	0)	V(BR)EBO	6.0	Hechimal Pani	OA Vdc
Collector Cutoff Current (I _E = 0, V _{CB} = 60 Vdc) (I _E = 0, V _{CB} = 60 V, T _A = 150°C)			_	10 10 10 10 10 10 10 10 10 10 10 10 10 1	nAdc
Emitter Cutoff Current (I _C = 0, V _{CB} = 4.0 Vdc)	IEBO	- -	10	nAdc	
ON CHARACTERISTICS	4 8 8 8 11 11 1 11 11 11	098.00	200 100 1 101 2	7837 3111-	
DC Current Gain(1) $ \begin{aligned} &(IC = 0.1 \text{ mA, VCE} = 10 \text{ Vdc}) \\ &(IC = 1.0 \text{ mA, VCE} = 10 \text{ Vdc}) \\ &(IC = 10 \text{ mAdc, VCE} = 10 \text{ Vdc}) \\ &(IC = 150 \text{ mAdc, VCE} = 10 \text{ Vdc}) \\ &(IC = 500 \text{ mAdc, VCE} = 10 \text{ Vdc}) \\ &(IC = 500 \text{ mAdc, VCE} = 10 \text{ Vdc}) \\ &(IC = 10 \text{ mA, VCE} = 10 \text{ V, TA} = -55^{\circ}\text{C}) \end{aligned} $	Commercial Product	hFE	50 75 100 100 30 35	325	
Collector-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc) (IC = 500 mAdc, IB = 50 mAdc)	eroor Jan I	VCE(sat)	0 8 C	0.3 1.0	Vdc
Base-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc) (IC = 500 mAdc, IB = 50 mAdc)	Group A, 8, C Sample	V _{BE} (sat)	0.6	1.2	Vdc
DYNAMIC CHARACTERISTICS	teel				- 0
Current-Gain — Bandwidth Product(1) (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	¥ Ship	f _T	250	800	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_{E} = 0$, $f = 1.0 \text{ MHz}$	Hz)	Cobo		8.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MH:	z)	Cibo		25	pF

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted)

Characteristic	267	0.8	60	Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS				25	вV	e Reverse	Standy Stal
Turn-On Time				ton	_	35	ns
$(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc},$ $I_{C} = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc}) \text{ (Figure 2)}$	Am		998		IFM	nd Content si ii 25°C Pote-Alt	
Turn-Off Time				toff	_	300	ns
$(V_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ mAdc}, I_{B1} = I_{B2} = 15 \text{ mAdc}) \text{ (Figure 3)}$					퀴	Forward t for below)	Continuous Europat s

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle = 2.0%.

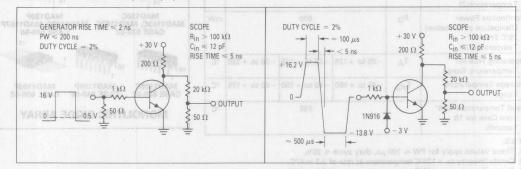


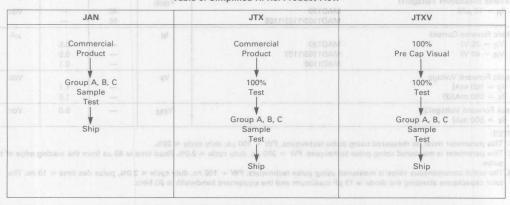
Figure 2. ton Test Circuit

Figure 3. toff Test Circuit

Table 2. JTX, JTXV 100% Processing Steps

		PLASTIC		
	F Sullix	P SURFIX	JTX 18 0	JTXV
Internal Visual (Mil-Std-750, Method 2072)	Pin	Pin	Pitt	100%
High Temperature Storage (Mil-Std-750, Method 10	032)	Ret No. Case	100%	100%
Thermal Shock (Mil-Std-750, Method 1051 Cond. F	*)	anana e	100%	100%
Constant Acceleration (Mil-Std-750, Method 2006, 2	20 KGs, Y ₁)		100%	100%
Hermetic Seal (Fine + Gross Leak) (Mil-Std-750, M	ethod 1071, Cond	. G or H)**	100%	100%
READ Electrical Parameters (Group A)			100%	100%
High Temperature Reverse Bias (Mil-Std-750, Meth	od 1039, Cond. A	80-656 2	100%	100%
READ Electrical Parameters (Group A)	oea r	50 848 08	100%	100%
Power Burn-In (Mil-Std-750, Method 1039, Cond. B)		100%	100%
READ Electrical Parameters (Group A)	fenu	Free-Air Tempera	100%	100%

Table 3. Simplified Hi-Rel Product Flow



 $^{^*}T(LOW) = -55^{\circ}C$ **Cond. G, Fine Leak = 1 x 10⁻⁷ ATM. CC/sec.

MAXIMUM RATINGS (@ 25°C Free-Air Temperature unless otherwise noted.)

Rating	Symbol	MAD130	MAD1103	MAD1107 MAD1108	Unit
Peak Reverse Voltage(1)	V _{RM}	40	50	50	Vdc
Steady-State Reverse Voltage	VR	25	25	40	Vdc
Peak Forward Current at (or below) 25°C Free-Air Temperature(1)	IFM	llo	500		mA
Continuous Forward Current at (or below) 25°C Free-Air Temperature(2)	lF	400			mA
Continuous Power Dissipation at (or below) 25°C Free-Air Temperature(3)	PD PD	600 MC = 33771 MTUG			mW
Operating Free-Air Temperature Range	TA	-65 to +125	-65 to +125	-55 to +150	°C
Storage Temperature Range	T _{stg}	-65 to +150	-65 to +150	-65 to +175	°C
Lead Temperature 1/16" from Case for 10 Seconds	VE	T STEMT	260	3,040	°C

MAD130, MAD1108 MAD1107, MAD1108 MAD1103F CASE 606-04 MAD130C MAD1103C MAD1103C MAD1103C, MAD1107C CASE 632-02 MAD130P MAD130P MAD1108C MAD1108C CASE 646-06 MAD1108C CASE 646-06 MAD1108C CASE 646-06 MAD1108C CASE 648-06 MAD1108C CASE 650-02 MONOLITHIC DIODE ARRAY

NOTES:

- 1. These values apply for PW \leq 100 μ s, duty cycle \leq 20%.
- 2. Derate linearity to +125°C temperature at rate of 3.2 mA/°C.
- 3. Derate linearity to +125°C temperature at rate of 6.0 mW/°C.

PACKAGE OPTIONS

		CERAMIC C Suffix		IC ix	FLAT CERAMIC F Suffix	
Device	Pin Connection Ref. No.	Case	Pin Connection Ref. No.	Case	Pin Connection Ref. No.	Case
MAD130 Dual 10-Diode Array	3	632-02	3	646-06	14V 8	(G)
MAD1103 Dual 8-Diode Array	5	632-02	5	646-06	507 4 Cond	606-04
MAD1107 Dual 8-Diode Array	2	632-02	2	646-06	A broo en	607-05
MAD1108 8-Diode Array	1	620-02	1	648-06	1	650-02

ELECTRICAL CHARACTERISTICS (@ 25°C Free-Air Temperature)

			Lin	E (SVO) BT ^a	
Cha	Symbol	Min	Max	Unit	
Reverse Breakdown Voltage(1) (I _R = 10 μA)	MAD130 MAD1103/1107/1108	V _(BR)	40 50	6 <u>=</u>	Vdc
Static Reverse Current (V _R = 25 V) (V _R = 40 V)	MAD130 MAD1103/1107 MAD1108	IR	_bioren _ tout	0.5 0.5 0.1	μΑ
Static Forward Voltage (I _F = 100 mA) (I _F = 500 mA)(2)	noosa Test	V _F	A, 8, C note	1.1 1.5	Vdc
Peak Forward Voltage(3) (IF = 500 mA)	Omug A, B, C	V _{FM}	- 1	5.0	Vdc

NOTES

- 1. This parameter must be measured using pulse techniques. PW = 100 μ s, duty cycle \leq 20%.
- This parameter is measured using pulse techniques. PW = 300 μs, duty cycle ≤ 2.0%. Read time is 90 μs from the leading edge of the pulse.
- The initial instantaneous value is measured using pulse techniques. PW = 150 ns, duty cycle ≤ 2.0%, pulse rise time ≤ 10 ns. The
 total capacitance shunting the diode is 19 pF maximum and the equipment bandwidth is 80 MHz.

$(I_F = 500 \text{ mA})$	'tr	20	ns
Reverse Recovery Time, Figure 2 (IF = 200 mA, IRM = 200 mA, RL = 100 Ω , irr = 20 mA)	t _{rr}	8.0	ns

PIN CONNECTION DIAGRAMS

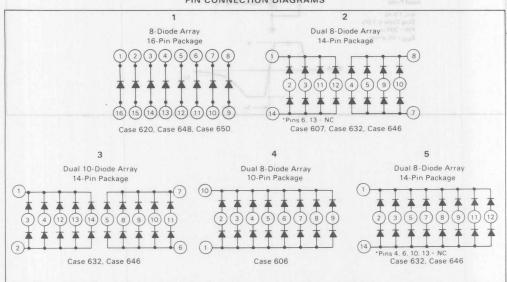


FIGURE 1 — TYPICAL CHARACTERISTICS STATIC FORWARD VOLTAGE

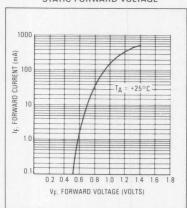
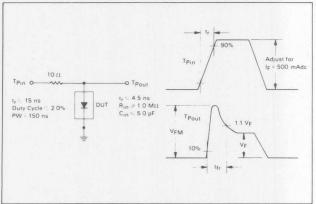


FIGURE 2 — FORWARD RECOVERY TIME AND PEAK FORWARD VOLTAGE TEST CIRCUIT AND WAVEFORMS





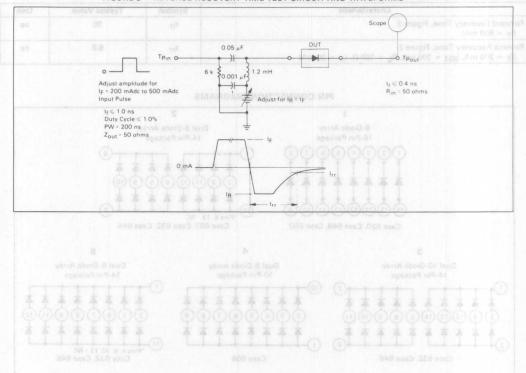
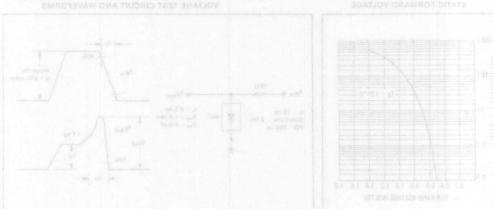


FIGURE 2 - FORWARD RECOVERY TIME AND PEAK FORWARD VOLTAGE TEST CIRCUIT AND WAVEFORMS



5

MAXIMUM RATINGS (@ 25°C Free-Air Temperature unless otherwise noted.)

Rating	Symbol	Value				
Peak Reverse Voltage(1)	V _{RM}	50				
Steady-State Reverse Voltage	VR	40				
Peak Forward Current at (or below) 25°C Free-Air Temperature(1)	IFM		500	13.01	mA	
Continuous Forward Current at (or below)	lF	20 č.l ≥	400		mA	
25°C Free-Air Temperature(2)	lup9l	CONTRACT TO THE STATE OF THE ST				
Continuous Power Dissipation at (or below) 25°C Free-Air Temperature(3)	PD	134	600		mW	
		MAD1109C	MAD1109F	MAD1109P	150	
Operating Free-Air Temperature Range	AT e and Pu	-65 to +175	-65 to +150	-55 to +125	°C	
Storage Temperature Range	T _{stg}	-65 to +200	-65 to +175	-55 to +150	°C	
Lead Temperature 1/16" from Case for 10 Seconds			260	700	°C	



NOTES

- 1. These values apply for PW \leq 100 μ s, duty cycle \leq 20%.
- 2. Derate linearity to +125°C temperature at rate of 3.2 mA/°C.
- 3. Derate linearity to +125°C temperature at rate of 6.0 mW/°C.

ELECTRICAL CHARACTERISTICS (@ 25°C Free-Air Temperature)

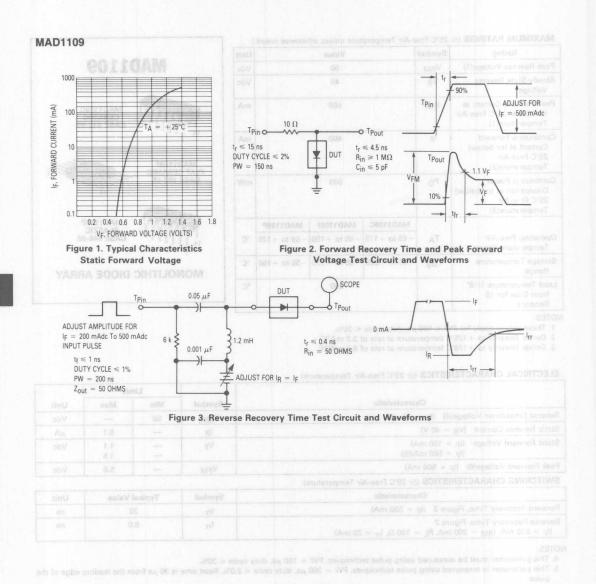
		Li	mit	3002
Characteristic	Symbol	Min	Max	Unit
Reverse Breakdown Voltage(4) (IR = 10 μ A), but Supply that smill years as	V(BR)	50	-	Vdc
Static Reverse Current (V _R = 40 V)	IR		0.1	μΑ
Static Forward Voltage (I _F = 100 mA) (I _F = 500 mA)(5)	VF	=	1.1 1.5	Vdc
Peak Forward Voltage(6) (I _F = 500 mA)	VFM	_	5.0	Vdc

SWITCHING CHARACTERISTICS (@ 25°C Free-Air Temperature)

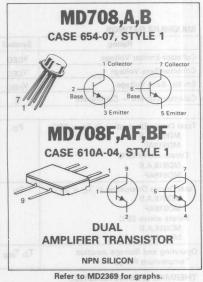
Characteristic	Symbol	Typical Value	Unit
Forward Recovery Time, Figure 3 (IF = 500 mA)	tfr	20	ns
Reverse Recovery Time, Figure 2 (IF = 200 mA, I _{RM} = 200 mA, R _L = 100 Ω , i _{rr} = 20 mA)	t _{rr}	8.0	ns

NOTES:

- 4. This parameter must be measured using pulse techniques. PW = 100 μ s, duty cycle \leq 20%.
- 5. This parameter is measured using pulse techniques. PW = 300 μ s, duty cycle \leq 2.0%. Read time is 90 μ s from the leading edge of the
- 6. The initial instantaneous value is measured using pulse techniques. PW = 150 ns, duty cycle ≤ 2.0%, pulse rise time ≤ 10 ns. The total capacitance shunting the diode is 19 pF maximum and the equipment bandwidth is 80 MHz.



MAXIMUM RATINGS Symbol Unit Value Rating Vdc Collector-Emitter Voltage VCEO 15 40 Vdc Collector-Base Voltage **VCBO** Emitter-Base Voltage **VEBO** 5.0 Vdc mAdc 200 Collector Current — Continuous IC **Both Die** One Die **Equal Power** PD mW **Total Device Dissipation** @ $T_A = 25^{\circ}C$ MD708, MD708A, MD708B 600 550 MD708F, MD708AF, MD708BF 350 400 Derate above 25°C MD708, MD708A, MD708B MD708F, MD708AF, MD708BF mW/°C 3.13 3.42 2.0 2.28 Total Device Dissipation Watts PD @ $T_C = 25^{\circ}C$ MD708, MD708A, MD708B 1.4 2.0 MD708F, MD708AF, MD708BF 0.7 1.4 mW/°C Derate above 25°C 11.4 8.0 MD708, MD708A, MD708B MD708F, MD708AF, MD708BF 8.0 -65 to +200°C Operating and Storage Junction T_J, T_{stg}



THERMAL CHARACTERISTICS

Temperature Range

WAD"	Characteristic 30.00	Symbol	One Die	Both Die Equal Power	Unit
Thermal Resistance,	Junction to Case	R _O JC			°C/W
	MD708, MD708A, MD708B MD708F, MD708AF, MD708BF	0.0000000	125 250	87.5 125	hermal Re
Thermal Resistance,	Junction to Ambient	$R_{\theta JA}(1)$	319 500	292 438	°C/W
983	William I are representative to		Junction to Ambient	Junction to Case	il mailting
Coupling Factors	MD708, MD708A, MD708B MD708F, MD708AF, MD708BF	MD918AF	83 75	40 0	%

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Characteristic	Symbol	Min and	Max	Unit
OFF CHARACTERISTICS	R oxugaV	age(2)	kaowa Yak	mitter Braa	Longraph
Collector-Emitter Breakdown Voltag	e(2) (I _C = 30 mAdc, I _B = 0)	V(BR)CEO	15	gl.,a <u>h</u> Ami (Vdc
Collector-Base Breakdown Voltage	$(I_C = 10 \mu Adc, I_E = 0)$	V(BR)CBO	40	inge <u>ra</u> sani	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0)$	V(BR)EBO	5.0	Bl Spiners I	Vdc
Collector Cutoff Current (V _{CB} = 2) (V _{CB} = 2)	0 Vdc, I _E = 0) 0 Vdc, I _E = 0, T _A = 150°C)	ІСВО	O)	15 30	nAdc μAdc
ON CHARACTERISTICS	083		10 =	STUDY HOLE	Neg mo
DC Current Gain(2)	(I _C = 500 µAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 100 mAdc, V _{CE} = 5.0 Vdc) (I _C = 150 mAdc, V _{CE} = 5.0 Vdc)	hFE 10/08	40 40 35 20	200	PER CHAR ON CHAR OC Curren
Collector-Emitter Saturation Voltage	e (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	VCE(sat)	1,0 Adel	0.20 0.35 0.50	Vdc
Base-Emitter Saturation Voltage	(I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50 mAdc, I _B = 5.0 mAdc) (I _C = 100 mAdc, I _B = 10 mAdc)	VBE(sat)	0.65	0.85 0.95 1.10	Vdc

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAYIMI IM BATINGS

MAXIMUM RATINGS		2834	1	1
Rating	Symbol	V	alue	Unit
Collector-Emitter Voltage	VCEO	abV	15	Vdc
Collector-Base Voltage	VCES	alsAm	30	Vdc
Emitter-Base Voltage	VEBO		3.0	Vdc
Collector Current — Continuous	IC		50	mAdc
testimā a satirnā c		One Die	Both Die	
Total Device Dissipation @ T _A = 25°C MD918,A,B MD918AF Derate above 25°C MD918,A,B MD918AF	PD	550 350 3.14 2.0	600 400 3.42 2.28	mW mW/°C
Total Device Dissipation (a T _C = 25°C MD918,A,B MD918AF Derate above 25°C MD918,A,B MD918AF	PD	1.4 0.7 8.0 4.0	2.0 1.4 11.4 8.0	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65	to +200	°C

MD918A MD918B



CASE 654-07, STYLE 1

MD918AF



CASE 610A-04, STYLE 1

DUAL AMPLIFIER TRANSISTOR

NPN SILICON

THERMAL CHARACTERISTICS

		Characteris	stic		Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case		MD918.A.B		R _θ JC ola	125	87.5	°C/W	
			MD918AF			250	125	Therms! 4e
Thermal R	esistance, Junctio	on to Ambient	MD918.A.B	A, WOYUSE BAF, MD7088F	$R_{\theta JA}(1)$	319	292	°C/W
WADP			MD918AF			500	438	er lermed
	850	900				Junction to	Junction to	
	Junetlen to					Ambient	Case	
Coupling F	actors	FREIGHA .						%
occpining i	704		MD918,A,B MD918AF			83 75	40 0	Coupling Fa

⁽¹⁾ $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		pirelie)	Charac		0	
Collector-Emitter Breakdown Voltage(2) (IC = 3.0 mAdc, IB = 0)	(0 =	V(BR)CEO	15 (2) sgs	ekdowa Vol	evolumen Imster Bro	Vdc
Collector-Base Breakdown Voltage (I _C = 1.0 μ Adc, I _E = 0)		V(BR)CBO		down-Voltage		Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)		V(BR)EBO	3.0	ant (Vog		1/-1-
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0) (V _{CB} = 15 Vdc, I _E = 0, T _A = 150°C)	1.0 Vdo)	CBO VAGE ACE			10 1.0	nAdc μAdc
ON CHARACTERISTICS		100 mad do Vot				
DC Current Gain (I _C = 3.0 mAdc, V _{CE} = 5.0 Vdc)	- Sull Vdc)	30V hFEm 081	50	165	ta 2 various	malic
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 Adc)		VCE(sat)		0.09	0.2	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		VBE(sat)		0.86	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	(abAm 0)	100 mAdc, lg = 1	= oil			
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)		f _T S = alb	600	100E > MINI	W dain's th	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _F = 0, f = 100 kHz)		C _{obo}	-	1.1	1.7	pF

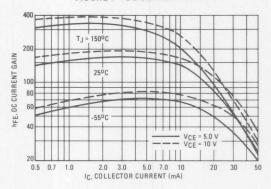
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit	
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)		C _{ibo}	20-1-05	1.15	2.0	pF
Noise Figure (I _C = 1.0 mAdc, V_{CE} = 6.0 Vdc, R_{S} = 400 Ω , f =	= 60 MHz)	NF	#- 2		6.0	dB
MATCHING CHARACTERISTICS			111 5			
DC Current Gain Ratio(3) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	MD918B MD918A,AF	hFE1/hFE2	0.8 0.9	_	1.0 1.0	-
Base-Emitter Voltage Differential (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	MD918B MD918A,AF	V _{BE1} -V _{BE2}	3.0	_	10 5.0	mVdc
Base-Emitter Voltage Differential Gradient (I _C = 1.0 mAdc, V_{CE} = 5.0 Vdc, T_{A} = -55 to + 125°C)	MD918B,AF MD918A	$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_{A}}$	1111eo	=	20 10	μV/dc °C

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

(3) The lowest hFE reading is taken as hFE1 for this ratio.

FIGURE 1 - DC CURRENT GAIN



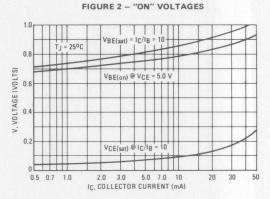


FIGURE 3 - BASE-EMITTER

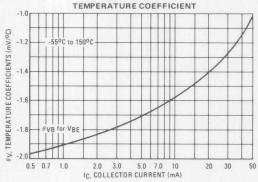
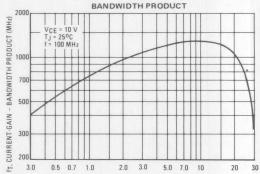
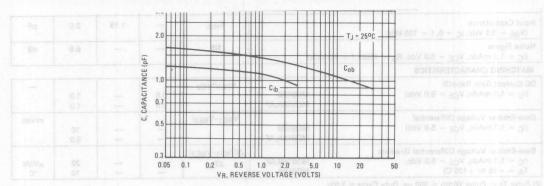
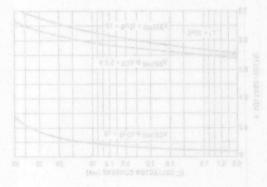


FIGURE 4 - CURRENT-GAIN

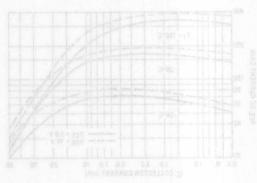


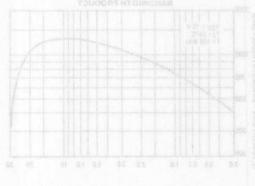


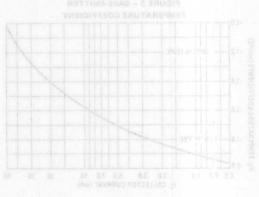












Collector Current — Continuous	Ic	60	00	mAdc
		One Die	All Die	10
Total Device Dissipation @ TA = 25°C	PD		09 0000	mW
MD982		600	650	400 60
MD982F	1 1 4	350	400	siG at
MQ982		400	600	949
Derate above 25°C		D*Wm		mW/°C
MD982	- 1 -	3.42	3.7	
MD982F		2.0	2.28	8.1
MQ982		2.28	3.42	2.01
Total Device Dissipation @ T _C = 25°C	PD	44	005	Watts
MD982		2.1	3.8	
MD982F	1 1 1	1.25	2.5	-
MQ982		1.0	4.0	
Derate above 25°C	1 100			mW/°C
MD982	1 1 1	12	17.2	
MD982F	1	7.15	14.3	eiG a
MQ982 MD01.112 9M9		5.71	22.8	10
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	+ 200	°C

CASE 654-07, STYLE 1

MD982F CASE 610A-04, STYLE DUAL

MQ982 CASE 607-04, STYLE 1 QUAD

QUAD 14
MAL CHARACTERISTICS

AMPLIFIER TRANSISTOR

PNP SILICON

THERMAL CHARACTERISTICS

			Characteris	stic		3 In	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case			MD982 MD982F MQ982	a baining le offinarwise	R _θ JC	83.3 140 175	58.3 70 43.8	°C/W		
Thermal	Resistance,	Junction to	Ambient	Jodniya	MD982		$R_{\theta JA}(1)$	292	270	°C/W
					MD982F MQ982			500 438	438 292	
Vac			04	060(85)V				Junction to Ambient	Junction to Case	Westor-Ba
Coupling	Factor		0.8	-063(88)V	MD982 MD982F			85 75	40	% % m
					MQ982 (Q1-Q2) Q1-Q3 or Q	11-Q4)	57 55	toff Curpant Vide, 10 = 0)	

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		9	stion Voltag	miner Satur	Showelfe
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	50	(abAr <u>u_</u> 0.7	mAde 1g	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	60	HOAIN O.E	BI GOVEN	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	fusike 0.1	el shame	Vdc
Collector Cutoff Current $(V_{CB} = 50 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 50 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$	СВО	= 8	NT SIRETOA	0.020	μAdc
ON CHARACTERISTICS(2)	(614)	to not a	othores man	marie Ver	DC = All
DC Current Gain $(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ $(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$ $(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	hFE	20 25 35 40	50 75 90 60	t: Pulled Wh	eT ealb
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	V _{CE(sat)}	-	0.25	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	V _{BE(sat)}	_	0.88	1.4	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	200	320	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	-	5.8	8.0	pF
Input Capacitance (VBF = 2.0 Vdc, IC = 0, f = 100 kHz)	Cibo	_	16	30	pF

MAXIMUM RATINGS Rating Symbol Value Unit Collector-Emitter Voltage VCEO 20 Vdc 40 Vdc Collector-Base Voltage **VCBO** 5.0 Vdc Emitter-Base Voltage VEBO Collector Current — Continuous 200 mAdc IC **Both Die** One Die **Equal Power** 575 625 mW Total Device Dissipation @ TA = mW/°C 25°C 3.29 3.57 Derate above 25°C Total Device Dissipation @ $T_C = 25^{\circ}C$ 2.5 Watts 1.8 Derate above 25°C 10.3 14.3 mW/°C Operating and Storage Junction TJ, Tstg -65 to +200 °C Temperature Range

THERMAL CHARACTERISTICS

Characteristic Characteristic	Symbol	One Die	Both Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{\theta}JC$	97	70	°C/W
Thermal Resistance, Junction to Ambient	304	280	°C/W	
All Die	Junction to Ambient	Junction to Case		
Coupling Factor	84 44			

CASE 654-07, STYLE 1

1 Collector 7 Collector

Base 3 Emitter 5 Emitter

DUAL AMPLIFIER TRANSISTOR

PNP SILICON

Refer to MD3250 for graphs.

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Characteris	tic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	292		ND982					
Collector-Emitter Breakdown (I _C = 10 mAdc, I _B = 0)	Voltage(2)		MESSE	V(BR)CEO	20	_	1	Vdc
Collector-Base Breakdown Vo $(I_C = 10 \mu Adc, I_E = 0)$	oltage			V _(BR) CBO	40	_	-	Vdc
Emitter-Base Breakdown Volt ($I_E = 10 \mu Adc, I_C = 0$)	age		SBEOM	V(BR)EBO	5.0		Te house	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0) (V _{CB} = 20 Vdc, I _E = 0, T _A	= 150°C)			СВО	_	=	25 30	nAdc μAdc
ON CHARACTERISTICS		ALTERNATION AND	THE RESERVED	HUNCH S COM	DESTRUCTION AND ADDRESS OF THE PARTY OF THE		MARKET CAN	en malaine
DC Current Gain(2) (I _C = 10 mAdc, V _{CE} = 10	Vdc)	Symbol	on selveron	hFE	25	75	-	_
Collector-Emitter Saturation (I _C = 10 mAdc, I _B = 1.0 m (I _C = 50 mAdc, I _B = 5.0 m	Adc)	VIBBICEO	(0 = g)	VCE(sat)	ji) (T iopal	0.18 0.38	0.3 0.5	Vdc
Base-Emitter Saturation Volta (IC = 10 mAdc, IB = 1.0 m		OspikalA		V _{BE(sat)}	01 = g0	0.8	0.9	Vdc
SMALL-SIGNAL CHARACTER	RISTICS	089	ma	10 =	gt pby dd s	A A A A A	enua nona.	10306810
Current-Gain — Bandwidth P (I _C = 20 mAdc, V _{CF} = 20		(Hz)		fT	250	550	ACTERISTICAL	MHz

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

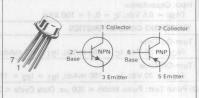
Auto (4) may mente automation.

MAXIMUM RATINGS

IVIAAIIVIOIVI NATIIVGS				
Rating 8.3	Symbol	ode0.	Value	Unit
Collector-Emitter Voltage	VCEO		30	Vdc
Collector-Base Voltage	Vсво	dal-/	60	Vdc
Emitter-Base Voltage	VEBO		5.0	Vdc
Collector Current — Continuous	lc	land land	500	mAdc
no - 27		One Die	Both Die Equal Power	
Total Device Dissipation (a TA = 25°C Derate above 25°C	PD	575 3.29 2.0	625 3.57 2.28	mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	1.8 2.5 10.3 14.3		Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 6	5 to +200	°C

MD985

CASE 654-07, STYLE 5



COMPLEMENTARY DUAL GENERAL PURPOSE TRANSISTOR

NPN/PNP SILICON

THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	Both Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{ heta JC}$	97	70	°C/W
hermal Resistance, Junction to Ambient	R _θ JA(1)	304	280	°C/W
		Junction to Ambient	Junction to Case	
Coupling Factors		84	44	%

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

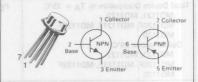
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, IB = 0)	V(BR)CEO	30	-	-	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	60		-	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	5.0	-	-	Vdc
Collector Cutoff Current $(V_{CB} = 50 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 50 \text{ Vdc}, I_E = 0, T_A = +150^{\circ}\text{C})$	ІСВО	=	_	20 20	nAdo μAdo
ON CHARACTERISTICS					
DC Current Gain (IC = 0.1 mAdc, V _{CE} = 10 Vdc) (IC = 1.0 mAdc, V _{CE} = 10 Vdc) (IC = 10 mAdc, V _{CE} = 10 Vdc) (IC = 150 mAdc, V _{CE} = 10 Vdc)	hFE	20 25 35 40	50 75 90 90	=	-
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	VCE(sat)		0.3	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)	V _{BE} (sat)	-	1.0	1.4	Vdc

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Symbol		Value	Unit		
VCEO		15 tewo9			
VCBO		40	Vdc		
VEBO	- Www	Vdc			
Ic		200	mAdc		
	One Die	Both Die Equal Power	3.29		
PD NO BOAG	550 3.14	600 3.42	mW mW/°C		
PD	1.4 8.0	2.0 11.4	Watts mW/°C		
TJ, T _{stg}	- 69	5 to +200	€ .c		
	VCEO VCBO VEBO IC PD	VCEO VCBO VEBO IC One Die PD 550 3.14 PD 1.4 8.0	VCEO 15 VCBO 40 VEBO 5.0 IC 200 Both Die Equal Power PD 550 600 3.14 3.42 PD 1.4 2.0 8.0 11.4		

MD986

CASE 654-07, STYLE 5



COMPLEMENTARY DUAL GENERAL PURPOSE TRANSISTOR

NPN/PNP SILICON

THERMAL CHARACTERISTICS

THE THINK O	THATTAGILITIO	1100						
Characteristic					Symbol	One Die	Both Die Equal Power	Unit
Thermal Resis	hermal Resistance, Junction to Case					125	87.5	°C/W
Thermal Resis	hermal Resistance, Junction to Ambient				$R_{\theta JA}(1)$	319	292	°C/W
						Junction to Ambient	Junction to Case	
Coupling Fact	ors 8.70	175		OF MOTIVE	1720F, MD117	83	40	%

(1) R_{0JA} is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Chai	racteristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	manul.							
Collector-Emitter Breakdown Voltage	(2) (I _C =	10 mAdc, IB	= 0)	V(BR)CEO	15	_	_ 1	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)					40	-	21005	Vdc
Emitter-Base Breakdown Voltage (I	$E = 10 \mu A$	dc, IC = 0)	E MOSTORE	V(BR)EBO	5.0	_		Vdc
Collector Cutoff Current (V _{CB} = 20 (V _{CB} = 20	СВО	- MO	=	25 30	nAdc μAdc			
ON CHARACTERISTICS		ione	printed circuit box	lation a typical	berebloe e	ith the daylo	w bonneson	n al ataR
DC Current Gain (Ic = 10 mAdc, VcE = 10 Vdc)			herwise noted.)	o sa hFE cras	25	ACTERNSTIN	RAHO JÁS	IAT JS.F
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	ned	loomys		VCE(sat)	2012112G 245		0.3	Vdc
$(I_C = 50 \text{ mAdc}, I_B = 10 \text{ mAdc})$	30	Vissiceo			T5.)ep	eticV m vobi	0.5	B-rotselle
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)				VBE(sat)	-	0) own Voltage	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS						(0	= glijabAu	01 - 08
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 20 Vdc, f =	0.8 = 100 MHz	OBBIREIV		fT	200	320 S	ie Smakdo ieAd <u>c</u> -IC =	1411.15
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kH	Hz)	0837		C _{obo}	-		4.0	

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	Val	ue	Unit
Collector-Emitter Voltage	VCEO	3	Vdc	
Collector-Base Voltage	VCBO	6	0	Vdc
Emitter-Base Voltage	VEBO	5.	0	Vdc
Collector Current — Continuous	Ic	50	00	mAdc
0.331.0 (0.400.3340		One Die	All Die Equal Power	eV.
Fotal Device Dissipation @ T _A = 25°C MD1121, MD1122 MD1120F, MD1121F, MD1122F MQ1120 Derate above 25°C MD1121, MD1122F MD1120F, MD1121F, MD1122F MQ1120	PD	575 350 400	625 400 600	mW
		3.29 2.0 2.28	3.57 2.28 3.42	mW/°C
Total Device Dissipation @ T _C = 25°C MD1120, MD1121, MD1122 MD1120F, MD1121F, MD1122F MQ1120 Derate above 25°C	PD	1.8 1.0 0.9	2.5 2.0 3.6	Watts
MD1120, MD1121, MD1122 MD1120F, MD1121F, MD1122F MQ1120		10.3 5.71 5.13	14.3 11.4 20.5	mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	+200	°C

MD1120F MD1121,F MD1122,F MQ1120

MD1121, MD1122 CASE 654-07, STYLE 1 7 1

MD1120F CASE 610A-04, STYLE 1

1

MQ1120 CASE 607-04, STYLE 1

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DUAL
AMPLIFIER TRANSISTOR
NPN SILICON

Refer to MD2218,A for graphs.

THERMAL CHARACTERISTICS

AAPT	0.12		-CSI	3(%)			9993 01 1	All Die	to A damian
			Characteristic			Symbol	One Die	Equal Power	Unit
Thermal Re	esistance, J	unction to (Para Veri	R_{θ} JC			°C/W
			MD11.	21, MD1122			97	70	
			MD11:	20F, MD1121F, N	ID1122F		175	87.5	
			MQ11:	20		San Landau and San Land	195	48.8	o oi a s
Thermal Re	esistance, J	unction to	Ambient		HILDRID DOUG	R ₀ JA(1)	STALLING SOLLS	IN TENT PER CONT	°C/W
			MD11	21, MD1122		visited senting 1990	304	280	CARTORIA
			MD11:	20F, MD1121F, N	1D1122F	COLUMN COLUMN CAND	500	438	
	xeM		MQ11	20			438	292	
							Junction to	Junction to	ATTACHARIA
SSV	-		15	O BOTTERS OF A	(0)	= 10 mAdo lg =	Ambient	Case	Unit
Coupling F	actors					made, lg = 0)	it = all again	v nwobilear8 ea	%
			MD11	21, MD1122				44	
			MD11:	20F, MD1121F, N	1D1122F		75	0	15 60 - 1973418
			- MQ11	20 (Q1-Q2)			57 9	Marino Tio	u3 notosille
				(Q1-Q3 or Q1	-04)		55	0	

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			(b)sAm 0.1	e gl. abAm	10 = 50
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, IB = 0)	V(BR)CEO	30	(shA <u>m</u> 01 egstloV n	mAd <u>c.</u> Ig. • n Saturatio	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	V(BR)CBO	60	1.0 mAda ACTERISTI	mAde is a	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO		idily T radis = 20 Vdc		Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 150°C)	СВО	Table 1	0, (= 100		nAdc μAdc
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)	IEBO	-	-	10	nAdc

MD1120F, MD1121,F, MD1122,F, MQ1120

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
ON CHARACTERISTICS							
DC Current Gain(2) ($I_C = 10 \ \mu Adc, \ V_{CE} = 10 \ Vdc$) ($I_C = 100 \ \mu Adc, \ V_{CE} = 10 \ Vdc$) ($I_C = 1.0 \ m Adc, \ V_{CE} = 10 \ Vdc$) ($I_C = 10 \ m Adc, \ V_{CE} = 10 \ Vdc$)	sinti	gold On	h _{FE}	20 30 40 50	40 50 60 65	100 120 160 200	URSDČAS
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	sbV	98	V _{CE(sat)}	19V =	80	100	mVdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	pav	00	V _{BE(sat)}	1	700	850	mVdc
SMALL-SIGNAL CHARACTERISTICS		Ali Die	One Die				
Current-Gain — Bandwidth Product(2) (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	Wm	esa	f _T	200	250	ce Olesipati 25 C	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	alteW(30.8	C _{obo}	e e	3.5	8.0	pF
MATCHING CHARACTERISTICS	TO Make	2.19	8.1			3785 mutud	OF TO SE
DC Current Gain Ratio(3) (IC = 100μ Adc, $V_{CE} = 10 V_{CE}$ All Devices (IC = 1.0μ Adc, $V_{CE} = 10 V_{CE}$ MD1122, MD	1122F	0 + 200	hFE1/hFE2	0.8 0.9	naltanul s	1.0 1.0	gailateq Tempet
Base-Emitter Voltage Differential (I _C = 100 μAdc, V _{CE} = 10 Vdc) All Devices (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) MD1122, MD1122F		V _{BE1} -V _{BE2}	8	on sinaro	10 5.0	mVdc	
Base-Emitter Voltage Differential Change Due to Temperature — MD1121, MD1122 (IC = 100 µAdc, VCE = 10 Vdc, TA = -55 to +2 (IC = 100 µAdc, VCF = 10 Vdc, TA = +25 to +1			Δ(V _{BE1} -V _{BE2})	Case Am ul ent	os nultanul. June rr an le	0.8	mVdc

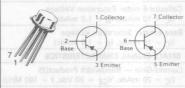
⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽³⁾ The lowest hee reading is taken as hee1 for this ratio.

MD1123 MD1130

MOT120F, MD1121,E, MOT122,E, M

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

PNP SILICON

MAXIMUM RATINGS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	40		Vdc
Collector-Base Voltage	VCBO	60		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	Ic	de lini	mAdc	
		One Die	All Die	
Total Device Dissipation (a) TA = 25°C Derate above 25°C	PD	575 3.29	625 3.57	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8	2.5 14.3	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65	°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{ heta}$ JC	97	70	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	304	280	°C/W
		Junction to Ambient	Junction to Case	IIC = ICI II Pulse Tell
Coupling Factors	or the rano.	84	44	%

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)		V(BR)CEO	40	_	-	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V(BR)CBO	60	-	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		V(BR)EBO	5.0	_	_	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0) (V _{CB} = 50 Vdc, I _E = 0, T _A = 150°C)		ІСВО	=	_	10 10	nAdc μAdc
Emitter Cutoff Current (V _{BE} = 3.0 Vdc, I _C = 0)		IEBO	-	_	10	nAdc
ON CHARACTERISTICS			1 F- TE		h l	
DC Current Gain(2) (I _C = 10 μ Adc, V _{CE} = 10 Vdc)	MD1130	hFE	60	100	j -	-
(I _C = 100 μ Adc, V _{CE} = 10 Vdc)	MD1123		30	80	120	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD1130		100	180	_	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD1123 MD1130		50 100	75 150	200	

	THE PARTY OF	BOILE		· · · · · · · · · · · · · · · · · · ·	174	IVIGA	Unit
Collector-Emitter Saturation Voltage			VCE(sat)	-	0.18	0.25	Vdc
(I _C = 10 mAdc, I _B = 1.0 Adc)	- Nels-	(10)	- Monde			Agree Voltage	Incosello.
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)			VBE(sat)	-	0.8	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS	DEFE	UG.	2,1,1,2,1,1		auguniji)(i	7.00	A TOLDWINE
Current-Gain — Bandwidth Product		ski mod skir s	fT				MHz
$(I_C = 20 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz})$		MD1123 MD1130	01	250 200	600 550	ce (<u>Careiper</u> boya 25°C	wsG.Isto
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	WW.C	A 2.0	C _{obo}	- 28 <u>rd</u>	3.5	4.0	pF
MATCHING CHARACTERISTICS	0	-68 to +200	graT LT		aginesia, e	and Storag	printing
DC Current Gain Ratio(3) (I _C = 100 μ Adc, V _{CE} = 10 Vdc)		MD1123 MD1130	hFE1/hFE2	0.8	etel <u>e</u> ato	1.0	AMARIM
Base-Emitter Voltage Differential (I _C = 100 μAdc, V _{CE} = 10 Vdc)	rielU	MD1123	V _{BE1} -V _{BE2}	WS _	(1)	10	mVdd
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$		MD1130	201 301	4 -	-	5.0	8 Jarman
Base-Emitter Voltage Differential Change Due to Temperature — MD1121, MD1122 (IC = 100 µAdc, VCF = 10 Vdc, TA = +25 to +			Δ V _{BE1} /V _{BE2}			sanO of	mVdd
	25°C)	MD1130	ers (f) _p	Pag		10	S Ismaari Subscut

⁽²⁾ Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

⁽³⁾ The lowest hee reading is taken as hee1 for this ratio.

MD1130F For Specifications, See MD1123 Data.

MAXIMUM RATINGS

Rating	Symbol	Value		Unit		
Collector-Emitter Voltage	VCEO	1	5	Vdc		
Collector-Base Voltage	VCBO	30		30		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc		
Collector Current — Continuous	IC	50		mAdc		
Land Control of the C		One Die	Both Die			
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	550 3.14	600 3.42	mW mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.4 8.0	2.0 11.4	Watts mW/°C		
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	o +200	°C		

THERMAL CHARACTERISTICS

THERIVIAL CHARACTERISTICS				
Characteristic	Symbol	One Die	Both Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{\theta}JC$	125	87.5	°C/W
Thermal Resistance, Junction to Ambient $R_{\theta JA}(1)$		319	292	°C/W
		Junction to Ambient	Junction to Case	Unit
Coupling Factors		83	40	%

MD1132,F MD1132F **CASE 610A-04, STYLE 1** MD1132 **CASE 654-07, STYLE 1** DUAL RF AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MD918 for graphs.

(1) $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				III.	
Collector-Emitter Breakdown Voltage(2) (I _C = 3.0 mAdc, I _B = 0)	V(BR)CEO	15		_	Vdc
Collector-Base Breakdown Voltage ($I_C = 1.0 \mu Adc, I_E = 0$)	V(BR)CBO	30	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	-		Vdc
Collector Cutoff Current $(V_{CB} = 15 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 15 \text{ Vdc}, I_E = 0, T_A = 150^{\circ}\text{C})$	ICBO		Ξ	10 1.0	nAdc μAdc
ON CHARACTERISTICS					1 7
DC Current Gain(2) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	hFE	50	_	-	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{CE(sat)}		0.2	0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VBE(sat)	-	0.7	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	600	800	-	-
Output Capacitance $(V_{CB} = 0, I_E = 0, f = 140 \text{ kHz})$ $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 140 \text{ kHz})$	C _{obo}	=	1.5 1.3	3.0 1.7	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 140 kHz)	Cibo	_	1.8	2.0	pF
MATCHING CHARACTERISTICS		TE CRE			
DC Current Gain Ratio(3) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	hFE1/hFE2	0.9	-	1.0	_
Base-Emitter Voltage Differential (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc)	VBE1-VBE2	_	_	5.0	mVdc
Base-Emitter Voltage Differential Change Due to Temperature (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, T _A = -55 to $+25$ °C) (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, T _A = $+25$ to $+125$ °C)	Δ(V _{BE1} -V _{BE2})	=	=	0.8 1.0	mVdc

⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽³⁾ The lowest hee reading is taken as hee1 for this ratio.

MAXIMUM RATINGS

		(.5	MD2218,A,F MD2219,A,F		25 - A
Rating	niNi	Symbol	MQ2218,A MQ2219,A	MD2218AF MD2219AF	Unit
Collector-Emitter Voltage		VCEO	30	40	Vdc
Collector-Base Voltage		VCBO	60	75	Vdc
Emitter-Base Voltage		VEBO	5.0	6.0	Vdc
Collector Current — Continuous	9.0	Ic	50	00	mAdc
D1994(1	20	Vao	One Die	All Die Equal Power	12219.F
Total Device Dissipation @ T _A = 25°C MD2218,A, MD2219,A		PD	575	625	mW
MD2218F,AF, MD2219F,AF MQ2218,A, MQ2219,A Derate above 25°C MD2218,A, MD2219,A MD2218F,AF, MD2219F,AF MQ2218,A, MQ2219,A	20	350	350 400 3.29 2.0 2.28	400 600 3.57 2.28 3.42	mW/°C
Total Device Dissipation @ T _C = 25°C MD2218,A, MD2219,A MD2218,A, MD2219,AF MQ2218,A, MQ2219,A Derate above 25°C MD2218,A, MD2219,A MD2218,A, MD2219,A MD2218,A, MD2219,A MQ2218,A, MQ2219,A	26 03 30 40 27	PD	1.8 1.0 0.9 10.3 5.71 5.13	2.5 2.0 3.6 14.3 11.4 20.5	Watts
Operating and Storage Junction Temperature Range	95	T _J , T _{stg}	- 65 to	+ 200	°C

MD2218,A,F,AF MD2219,A,AF MQ2218,A MQ2219,A

MD2218,A MD2219,A CASE 654-07, STYLE 1

MD2218F,AF MD2219,AF CASE 610A-04, STYLE 1

MQ2218,A MQ2219,A

DUAL
AMPLIFIER TRANSISTOR
NPN SILICON

THERMAL CHARACTERISTICS

		Characteristic	12218.8	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance,	Junction 1	to Case	MD2218,A, MD2219,A MD2218F,AF, MD2219,AF MQ2218,A, MQ2219,A	R _θ JC	97 175 195	70 87.5 48.8	°C/W
Thermal Resistance,	Junction 1	to Ambient	MD2218,A, MD2219,A MD2218,F,AF, MD2219,AF MQ2218,A, MQ2219,A	R _θ JA(1)	304 500 438	280 438 292	°C/W
			2219.A, MO2218.A	ETBLALE, MIDD	Junction to Ambient	Junction to Case	AC # 30
Coupling Factors	263		MD2218,A, MD2219,A MD2218F.AF. MD2219,AF	SOM RASIS	84 75	44	%
			MQ2218,A, MQ2219,A (Q1-Q2)	or Q1-Q4)	57 55		ar = 30

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

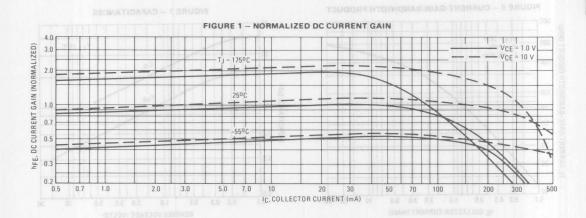
0.5 Cha	aracteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		ET SEALURE CHINESIS				
Collector-Emitter Breakdown Voltag (I _C = 10 mAdc, I _B = 0)		V(BR)CEO			na0 — nisil	
	MD2218,A,F, MD2219,A, MQ2218,A,	TSHIN	001 = 3.5	DV DS = HO	W.pbAm 03	
	MQ2219,A		30		son wi osos	
	MD2218AF, MD2219AF		40	12 Tal 16	10 Volc. Is	
Collector-Base Breakdown Voltage		V(BR)CBO			annatioed	Vdc
$(I_C = 10 \mu Adc, I_E = 0)$			(sHs/-00)	-1.0 - 1	0.5 Vde, I	
	MD2218,A,F, MD2219,A, MQ2218,A,	25CIM. A.A.819				
	MD2219,A	5.010	60	_	_	
	MD2218AF, MD2219AF	ROSCIEL BARRES	75	_	_	

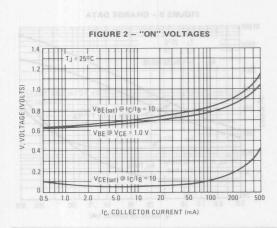
Emitter-Base Breakdown Voltage		V(BR)EBO			sV rettire3	Vdc
$(I_E = 10 \ \mu Adc, I_C = 0)$	MD2218.A.F. MD2219.A. MQ2218.A.	Veso			sileV east	Collector
	MQ2219,A	OttaV	5.0	-	dellay sec	Eminer-I
A RECORD	MD2218AF, MD2219AF	- V93	6.0	-	20000000	on landle
Collector Cutoff Current (VCE = 50 Vdc, VEB(off) = 3.0 Vd	de) and the	ICEV				nAdc
CE , EB(OII)	MD2218,F, MD2219,F, MQ2218,A MD2218A,AF, MD2219A,AF, MQ2219,A	110	20 15	_	_	
Base Cutoff Current	IM Wm	IBL	30	_ 001	sgiesiū son	nAdc
(V _{CE} = 50 Vdc, V _{EB(off)} = 3.0 Vd	10)			Approx	M A SIES	24
ON CHARACTERISTICS(2)	80 400 100		- 4	MOZZISE A	SZ18F, AF, I	IN
DC Current Gain		hFE			2218,A, W.	printer?
$(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD2218,A,F,AF, MQ2218,A MD2219,A,AF, MQ2219,A		20 35	50 45	2214A M	M M
	3.42			ARTES	M ALBISSI	0.01
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	NO.	- 99			on Dissilpe	Total Des
	MD2218,A,F,AF, MQ2218,A MD2219,A,AF, MQ2219,A		25 50	55 55	25°C (22165A, MI	oT 69 IM
(I _C = 10 mAdc, V _{CE} = 10 Vdc)			1		3278F.A.P.	16/4
TIC - TO MAGE, TEE - TO THE	MD2218,A,F,AF, MQ2218,A		35	65	22218,A, WI.	(NV)
	MD2219,A,AF, MQ2219,A		75	85	M ATT 152	NA.
(la = 150 mAda Va= = 1.0 Vda)		8	1		22182,46,	154
$(I_C = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	MD2218,A,F,AF, MQ2218,A		20	65	2218,A, M	RA-
	MD2219,A,AF, MQ2219,A	graT .LT	50	65	end Stone	nitssegC egmeT
(I _C = 150 mAdc, V _{CF} = 10 Vdc)						
, C	MD2218,AF,AF, MQ2218,A		40	30	120	MRSHT
	MD2219,A,AF, MQ2219,A		100	120	300	
(I _C = 300 mAdc, V _{CE} = 10 Vdc)		pitali	Characto			
11C = 300 111Ade, VCE = 10 Vde,	MD2218,A, MQ2218,A		25	75	donat-izañon	[memail]
20	MD2219,A, MQ2219,A	LAZGIV	30	75	_	
Collector-Emitter Saturation Voltage	A. MG2219.A	VCE(sat)				Vdc
(I _C = 150 mAdc, I _B = 15 mAdc)	MD2218,A,F, MD2219,A, MQ2218,A,		IneidmA d		Anners in the	lormad)
	MQ2219,A	ISSGM		0.2	0.4	
	MD2218AF, MD2219AF	MOSE	_		0.3	
(la = 300 mAda l= = 30 mAda)		MOZZ				
(IC = 300 mAdc, IB = 30 mAdc)	MD2218,A,F, MD2219,A, MQ2218,A,					
	MQ2219,A			0.35	1.2	
40	MD2218AF, MD2219AF	receis.	_	_	0.9	Coupling
Base-Emitter Saturation Voltage $(I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$	8F,AF, MD2218,AF 8.A. M03218,A (01-02)	V _{BE} (sat)				Vdc
	MD2218,A,F, MD2219,A, MQ2218,A, MQ2219,A		0.6	0.95	1.3	
	MD2218AF, MD2219AF	nd into a typic	0.6	1.0	1.2	i Kaja is
(IC = 300 mAdc, IB = 30 mAdc)N	MD2218,A,F, MD2219,A, MQ2218,A,	- 25°C unless	ATI BOTT		AHD JACK	TOBUS
rint man qyT	MQ2219,A	aifi	Cho <u>r s</u> ocen	-	2.0	
	MD2218AF, MD2219AF		_	-031	1.8	uzo som
SMALL-SIGNAL CHARACTERISTICS			(610000)	Wagash.	and medical	and the Control of th
Current-Gain — Bandwidth Product $(I_C = 20 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f$		fT ESBM RABIS	200	250	gi jobilni 0	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 k	08 Hz)	C _{obo}	_MGR MBB	3.5	8.0	pF
Input Capacitance	OSD(SS)V	Cibo	691	aloV nwoo	Başı Brakı	pF
$(V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0, f = 100 \text{ I})$	(Hz)				al jabas 0	- 30
	MD2218,A,F, MD2219,A, MQ2218,A,	118,A,E, M022 218,A	SOM			
	MQ2219,A MD2218AE MD2218AE	PIRAF MEDIN	2004	15	20	
	MD2218AF, MD2219AF	Topografi (tempi)		18	25	

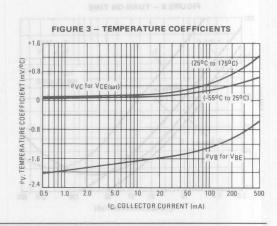
ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

STORANG BO	Characteristic		Min	Тур	Max	Unit
SWITCHING CHARA	CTERISTICS					III I
Delay Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc, V _{BE} (off) = 0.5 Vdc, I _{B1} = 15 mAdc) MD2218,F, MD2219 MD2218A.AF, MD2219A,AF	^t d		_	20	μs
Rise Time	MD2218,F, MD2219 MD2218A,AF, MD2219A,AF	AUUT TEA			40 30	μs
Storage Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc, I _{B1} = I _{B2} = 15 mAdc)				280	
	MD2218,F, MD2219 MD2218A,AF, MD2219A,AF	Au an ts		7	250	μS
Fall Time	MD2218,F, MD2219 MD2218A,AF, MD2219A,AF	tf			70 60	μs

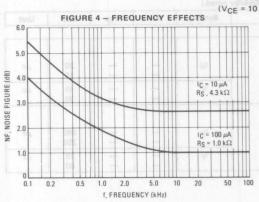
⁽²⁾ Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

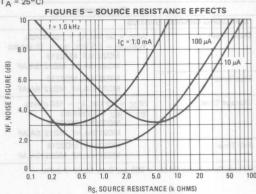


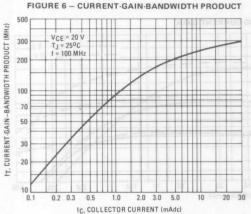


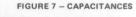


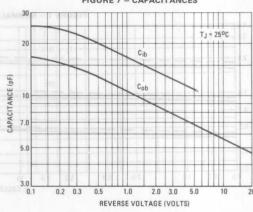
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



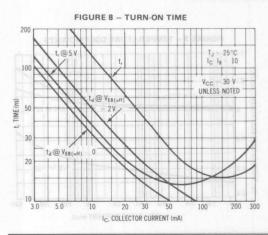


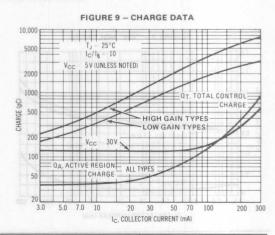




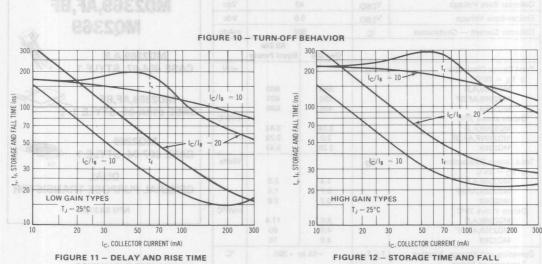


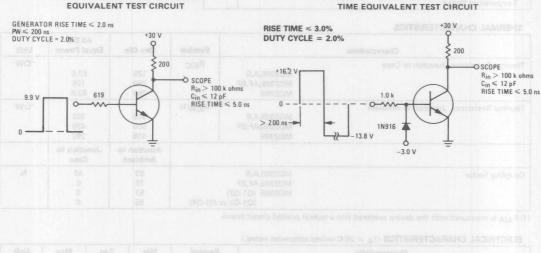
SWITCHING TIME CHARACTERISTICS





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





Emitter-Base Voltage	VEBO		5.0	Vdc
Collector Current — Continuous	Ic		500	mAdc
THE HURTES		One Die	All Die Equal Power	
Total Device Dissipation	PD	7 - 1 or		mW
$@ T_A = 25^{\circ}C$	il elle I			
MD2369,A,B		550	600	
MD2369,AF,BF		350	400	01 = 10
MQ2369	1	400	600	
Derate above 25°C	1 1		- In	mW/°0
MD2369,A,B		3.14	3.42	1
MD2369F,AF,BF		2.0	2.28	The same
MQ2369		2.28	3.42	
Total Device Dissipation	PD		8	Watts
$@ T_{C} = 25^{\circ}C$			03	
MD2369,A,B		1.4	2.0	
MD2369,AF,BF		0.7	1.4	1
MQ2369	GAIN TYPES	0.7	2.8	
Derate above 25°C	3.92 - 7			mW/°C
MD2369,A,B		8.0	11.4	l. I
MD2369,AF,BF	20 30	4.0	80	200
MQ2369		4.0	16	
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65	to +200	°C

MQ2369

MD2369,A,B
CASE 654-07, STYLE 1

MD2369,AF,BF
CASE 610A-04, STYLE 1

MQ2369
CASE 607-04, STYLE 1

DUAL
GENERAL PURPOSE TRANSISTOR

NPN SILICON

THERMAL CHARACTERISTICS

Characteristic	DUTY CYCLE	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	MD2369,A,B MD2369,AF,BF MQ2369	R _O JC	125 250 250	87.5 125 848 62.6	°C/W
Thermal Resistance, Junction to Ambient	MD2369,A,B MD2369,AF,BF MQ2369	R _θ JA(1)	319 500 438	292 438 292	°C/W
V 0.5-			Junction to Ambient	Junction to Case	
Coupling Factor	MD2369,A,B MD2369,AF,BF MQ2369 (Q1-Q2) (Q1-Q3)	or Q1-Q4)	83 75 57 55	40 0 0 0	%

(1) R_{BJA} is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, IB = 0)	V(BR)CEO	15	_	_	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	40	_	_	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	V(BR)EBO	5.0		_	Vdc
Collector Cutoff Current $(V_{CB} = 20 \text{ Vdc}, I_E = 0)$ $(V_{CB} = 20 \text{ Vdc}, I_E = 0, T_A = +150^{\circ}\text{C})$	СВО	_	_	0.03	μAdc
ON CHARACTERISTICS(2)					
DC Current Gain (I _C = 10 mAdc, V_{CE} = 1.0 Vdc) (I _C = 10 mAdc, V_{CE} = 1.0 Vdc, T_{A} = -55° C)	hFE	40 20	95	140	_

μV/°C

10

20

Characteristic	Symbol	Min	Тур	Max	Unit
Collector-Emitter Saturation Voltage (IC = 10 mAdc, Ig = 1.0 mAdc)	VCE(sat)	01-8	-	0.25	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 1.0 mAdc)	V _{BE} (sat)	0.7	3.5	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS				VET	
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	500	800	in 00 <u>E</u> 4 mil	MHz
Output Capacitance (VCB = 5.0 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	-	-	4.0	pF
Input Capacitance (VBE = 1.0 Vdc, I _C = 0, f = 100 MHz)	Cibo	BOMATI	A9A2 - S	4.0	pF
SWITCHING CHARACTERISTICS	2705 534			-	
Storage Time $(V_{CC} = 10 \text{ Vdc}, I_C = I_{B1} = I_{B2} = 10 \text{ mAdc})$	t _s	11-12-		13	ns
Turn-On Time $(V_{CC} = 3.0 \text{ Vdc}, V_{BE(off)} = 1.5 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = 3.0 \text{ mAdc})$	ton		+11	15	ns
Turn-Off Time ($V_{CC} = 3.0 \text{ Vdc}$, $I_{C} = 10 \text{ mAdc}$, $I_{B1} = 3.0 \text{ mAdc}$, $I_{B2} = 1.5 \text{ mAdc}$)	toff			20	ns
MATCHING CHARACTERISTICS					
DC Current Gain Ratio(3) (I _C = 3.0 mAdc, V _{CE} = 1.0 Vdc) MD2369A, MD2369AF MD2369B, MD2369BF	hFE1/hFE2	0.9 0.8		1.0	
Base-Emitter Voltage Differential (I _C = 3.0 mAdc, V _{CE} = 1.0 Vdc) MD2369A, MD2369AF MD2369BF, MD2369BF	VBE1-VBE2	0.8_ 0	<u>93</u> 4710°+4283	5.0	mVdc

(2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

 $(I_C = 3.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc},$

Base-Emitter Voltage Differential Gradient

 $T_A = -55 \text{ to } + 125^{\circ}\text{C}$

(3) The lowest hee reading is taken as hee1 for this test.

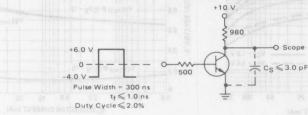
FIGURE 1 - STORAGE TIME TEST CIRCUIT

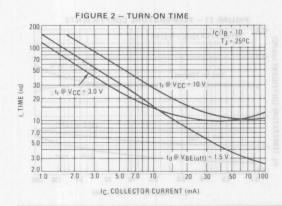
MD2369A, MD2369AF

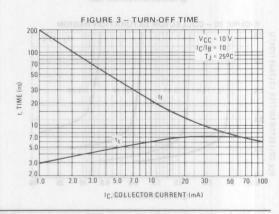
MD2369B, MD2369BF

 $\Delta(V_{\text{BE1}}-V_{\text{BE2}})$

 ΔT_A







MAXIMUM RATINGS

Rating	Symbol	MD2904,F MD2905,F MQ2904	MD2904A,AF MD2905A,AF MQ2905A	Unit
Collector-Emitter Voltage	VCEO	40	60	Vdc
Collector-Base Voltage	VCBO	UB2	60	Vdc
Emitter-Base Voltage	VEBO	!	5.0	Vdc
Collector Current — Continuous	Ic		600	mAdc
50 – 70 –	20	One Die	All Die Equal Power	AD2204 AD2904
Total Device Dissipation @ T _A = 25°C	PD	575 350 400 3.29 2.0 2.28	625 400 600 3.57 2.28 3.42	mW/°C
Total Device Dissipation @ T _C = 25°C MD2904,A, MD2905,A MD2904F,AF, MD2905F,AF M02904, M02905A Derate above 25°C MD2904,A, MD2905,A MD2904F,AF, MD2905,AF M02904, M02905A	PD OPF	1.8 1.0 0.9 10.3 5.71 5.13	2.5 2.0 3.6 14.3 11.4 20.5	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 t	to +200	°C

MD2904,A,F,AF MD2905,A,AF MQ2904, MQ2905A

MD2904,A MD2905,A CASE 654-07, STYLE 1



MD2904F,AF MD2905,AF CASE 610A-04, STYLE 1

1 9 0 0

MQ2904 MQ2905A CASE 607-04, STYLE 1 DUAL



AMPLIFIER TRANSISTOR
PNP SILICON

THERMAL CHARACTERISTICS

			Characteris	tic	Symbol	One Die	All Die Equal Power	Unit
Thermal R	esistance, J	unction to	Case	MD2904,A, MD2905,A MD2904F,AF, MD2905,A MQ2904, MQ2905A	R _B JC	97 175 195	70 87.5 48.8	°C/W
Thermal R	esistance, J	unction to	Ambient		$R_{\theta JA}(1)$	(384x-001 =	Vdc, lg = 0, f	°C/W
				MD2904,A, MD2905,A MD2904F,AF, MD2905,A MQ2904, MQ2905A	F	304 500 438	280 438 292	put George Vgg = 21
an	45			no ¹	.50V € 0 ± 361	Junction to Ambient	Junction to Case	niT eGene
Coupling F	Factor	-	2-41	b!		ab/m (8) = -		%
20				MD2904,A, MD2905,A		84	44	SWIT ST
				MD2904F,AF, MD2905,A MQ2904, MQ2905A (Q1		75 57	0	mF HÖ-m
				(Q1	-Q3 or Q1-Q4)	55	0	mil eggic

⁽¹⁾ $R_{\theta \text{JA}}$ is measured with the device soldered into a typical printed circuit board.

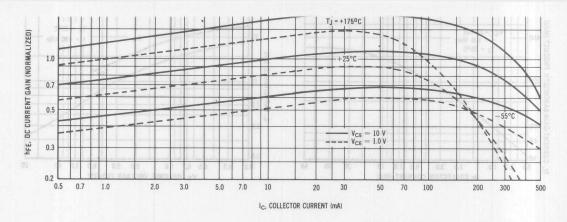
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

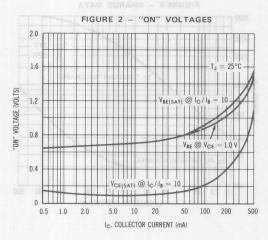
Characteristic		Symbol	Min	Тур	Max	Unit		
OFF CHARACTERISTICS								
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	MD2904, MD2905 MD2904A, MD2905A	V _{(BR)CEO}	40 60	=	_	Vdc		
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)		V _(BR) CBO	60	_	1-1	Vdc		
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$		V _{(BR)EBO}	5.0	-	-	Vdc		
Collector Cutoff Current ($V_{CB} = 50 \text{ Vdc}$, $I_{E} = 0$) ($V_{CB} = 50 \text{ Vdc}$, $I_{E} = 0$, $T_{A} = 150^{\circ}\text{C}$)		СВО		=	0.020	μAdc		

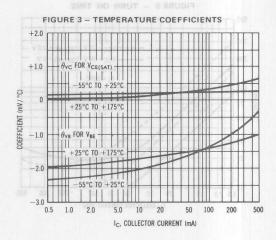
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

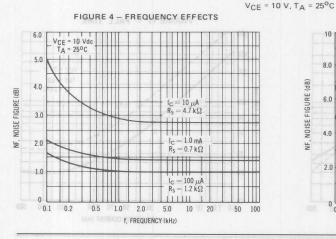
Character	istic	Symbol	Min	Тур	Max	Unit
Emitter Cutoff Current (VBF = 3.0 Vdc, IC = 0)		IEBO	BDV I	- 00	30	nAdc
ON CHARACTERISTICS(2)	SO Vac	0	gaV [e Voluage	mitter-Bos
DC Current Gain	30 mAde 00	hFE	0	aunumano	3 - meri	. rojesile
(IC = 0.1 mAdc, VCE = 10 Vdc)	MD2904		20	50	_	
	MD2904A	old one	40	70	_	
	MD2905		35	70	otropiosti e	ved late
	MD2905A		75	150	75°C	- AT 00
(I _C = 1.0 mAdc, V _{CE} = 10 Vdc)	MD2904	875	25	75		DESCIM
(IC - 1.0 MAde, VCE - 10 Vdc)	MD2904A	988	40	75	IGM JA 31	
	MD2905	-0.04	50	100	epacopi y	
	MD2905A		100	175	Sough End	stenou
	MD2000A	2.29		26 3000	LA, MOZBI	
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD2904	2.28	35	90	enes.DM .	MOSS
	MD2904A	- 27	40	90		-
	MD2905		75	110		1000
	MD2905A	B. C -	100	200	ISTC MOZSE	
(I _C = 150 mAdc, V _{CE} = 10 Vdc)	MD2904,A,	0.1	40	90	The second second	
(IC = 130 MAde, VCE = 10 Vde)	MD2905,A	0.9	100	200	300	
				14.5757 10	OVES BVO	Corate at
$(I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD2904	nor	20	60	DECEMA A	
	MD2904A	17.9	40	80		
	MD2905	5.13	30	130	SESSON 'Y	0FZDM
	MD2905A	1/13	50	150	posture by	d constance
Collector-Emitter Saturation Voltage		VCE(sat)			ure Hange	Vdc
(I _C = 150 mAdc, I _B = 15 mAdc)			_	0.25	0.4	
(I _C = 500 mAdc, I _B = 50 mAdc)				0.5	1.6	
Base-Emitter Saturation Voltage		VBE(sat)	1000	PERISTICS	CHARAGE.	Vdc
(I _C = 150 mAdc, I _B = 15 mAdc)				0.88	1.3	
(I _C = 500 mAdc, I _B = 50 mAdc) SMALL-SIGNAL CHARACTERISTICS	todays		biret-west	1.0	2.0	
	DUSE		200	220	T spendolo	NAU I
Current-Gain — Bandwidth Product(3) (IC = 50 mAdc, VCE = 20 Vdc, f = 100	MHz)		200	320	1000	MHz
Output Capacitance	2905A	Cobo	_	5.8	8.0	pF
(V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)		-000	Insidm	A of dollars	L monerals	ermel 80
Input Capacitance	A.200201	Cibo		16	30	pF
$(V_{BF} = 2.0 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$		14 110 110 I				P.
SWITCHING CHARACTERISTICS	Auces	ASA CECHINASIN				
Turn-On Time (Vac = 20 Vd	c, V _{BE} = 0.5 Vdc,	ton	_	_	45	ns
Delay Time IC = 150 mAc		td	_		12	ns
Rise Time IB1 = 15 mAc					35	ns
Turn Off Time	NA, RUESUM	toff			130	ns
Storage Time (V _{CC} = 30 Vd		ts			100	ns
los - los - 1	5 mAdc)					
Fall Time	hred furnit board.	ng Isaigy to otni	DEPENDS 9	alveb or li rit	40	ns

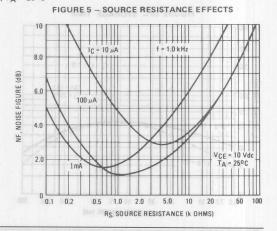
(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%. (3) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.







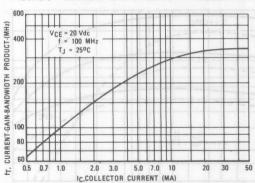


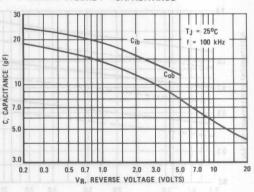


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

NOISE FIGURE

FIGURE 6 - CURRENT-GAIN BANDWIDTH PRODUCT





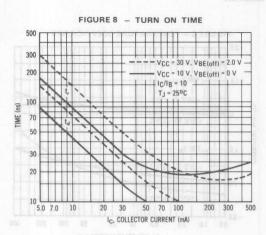


FIGURE 9 - CHARGE DATA

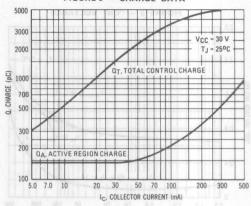


FIGURE 10 - STORAGE TIME 500

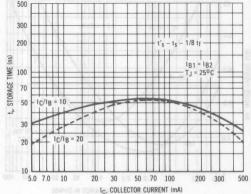
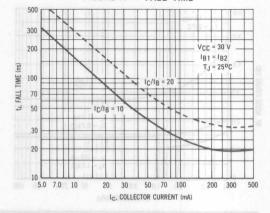
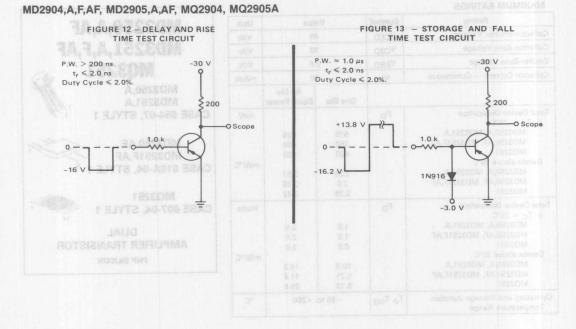


FIGURE 11 - FALL TIME





THERMAL CHARACTERISTICS

		Junction to Case	

ECTRICAL CHARACTERISTICS (TA = 20°C unissa otherwise noted.)

Collector-Base Voltage	VCBO		50	Vdc
Emitter-Base Voltage	VEBO	mor - W	Vdc	
Collector Current — Continuous	IC	50		mAdc
2000		One Die	All Die Equal Power	
Total Device Dissipation @ T _A = 25°C MD3250,A, MD3251,A MD3250,AF, MD3251F,AF MO3251 Derate above 25°C MD3250,A, MD3251,A	PD	575 350 400 3.29	625 400 600 3.57	mW/°C
MD3250,AF, MD3251F,AF MQ3251 Total Device Dissipation	PD	2.0 2.28	2.28 3.42	Watts
@ T _C = 25°C MD3250,A, MD3251,A MD3250,AF, MD3251F,AF MQ3251 Derate above 25°C MD3250,A, MD3251,A MD3250,AF, MD3251F,AF MQ3251		1.8 1.0 0.9 10.3 5.71 5.13	2.5 2.0 3.6 14.3 11.4 20.5	mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 65 t	0 +200	°C

MD3251,A,F,AF M03251

MD3250,A MD3251,A CASE 654-07, STYLE 1



MD3250,AF MD3251F,AF CASE 610A-04, STYLE 1



MQ3251 CASE 607-04, STYLE 1



DUAL
AMPLIFIER TRANSISTOR
PNP SILICON

THERMAL CHARACTERISTICS

Characteris	tic	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junctioh to Case	MD3251,A, MD3251,A MD3250,AF, MD3251F,AF MQ3251	$R_{\theta JC}$	97 175 195	70 87.5 48.8	°C/W
Thermal Resistance, Junction to Ambient	MD3250,A, MD3251,A MD3250,AF, MD3251F,AF MQ3251	R _θ JA(1)	304 500 438	280 438 292	°C/W
			Junction to Ambient	Junction to Case	
Coupling Factors					%
	MD3250,A, MD3251,A		84	44	
	MD3250,AF, MD3251F,AF		75	0	
	MQ3251 (Q1-Q2)		57	0	
	(Q1-Q3 or Q1-Q4)		55	0	

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

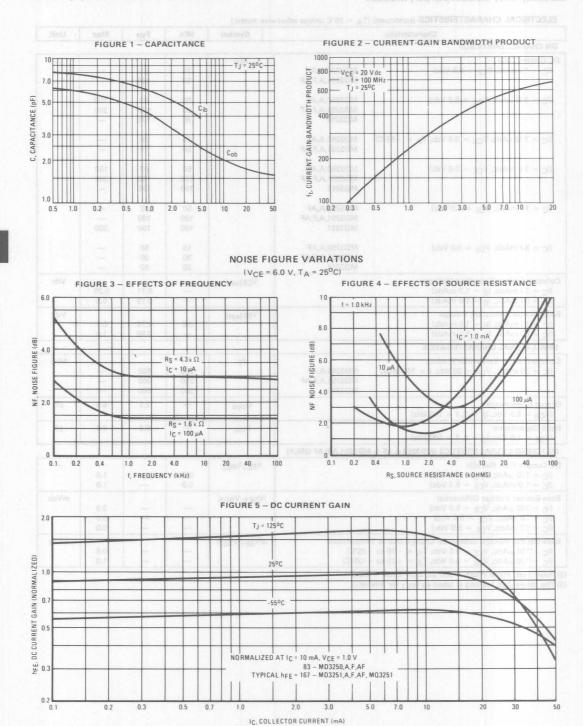
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

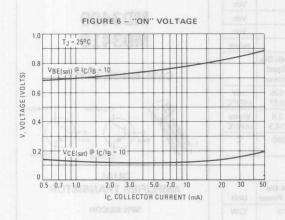
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	-	_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	V(BR)CBO	50	-	14-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	E E	-	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 40 Vdc, I _E = 0, T _A = 150°C)	ІСВО	_	_	10 10	nAdc μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)	IEBO	-	_	10	nAdc

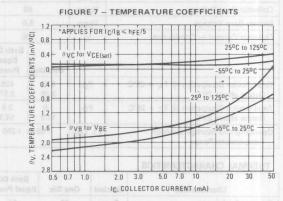
MD3250,A,AF, MD3251,A,F,AF, MQ3251

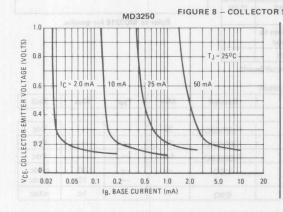
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

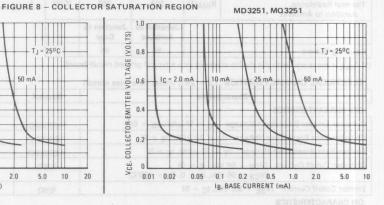
Characteristic		Symbol	Min	Тур	Max	Unit
ON CHARACTERISTICS(2)	A SHISTING		BURNING	A4A0 - 13	RUDIR	
DC Current Gain	0601	hFE	THE T	THE PROPERTY OF		mrze6
$(I_C = 10 \mu Adc, V_{CE} = 5.0 Vdc)$	MD3250,A,AF		25	75		
0000	MD3251,A,F,AF		50	100		
$(I_C = 100 \mu Adc, V_{CE} = 5.0 Vdc)$	MD3250,A,AF		50	82	150	all High
	MD3251,A,F,AF		80	170	300	
	MQ3251		80	170	-	
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_A = -55^{\circ}C)$	MD3250,A,AF		25	35		
	MD3251,A,F,AF	1 0001111	50	75	_	
	1400000 1 15				450	111110
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	MD3250,A,AF		50	87	150	
	MD3251,A,F,AF		100	180	300	
	MQ3251		100	180		
(I= 10 = Ada)/== E 0 \/da\	MADOOFO A AF		FO 95	02		HILLI O
(I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	MD3250,A,AF	46 46 01	50	100	-	183 6.0
	MD3251,A,F,AF		100	190	200	
	MQ3251		100	190	300	
(I _C = 50 mAdc, V _{CE} = 5.0 Vdc)	MD3250,A,AF		15	50		
IIC - 30 HIAGE, VCE = 3.0 VGE)	MD3251,A,F,AF	CIALS SELECT	30	90		
	MQ3251,A,F,AF	UINT SSICK	30	90		
	120 MAY 12 MAY 12 MAY	04-5591	30	30		
Collector-Emitter Saturation Voltage		VCE(sat)		EFFECTS	GUME 3 -	Vdc
(I _C = 10 mAdc, I _B = 1.0 mAdc)				0.11	0.25	وسننيا
(I _C = 50 mAdc, I _B = 5.0 mAdc)	REDTOR !			0.18	0.5	
Base-Emitter Saturation Voltage		VBE(sat)				Vdc
(I _C = 10 mAdc, I _B = 1.0 mAdc)			0.6	0.78	0.9	1-7
(I _C = 50 mAdc, I _B = 5.0 mAdc)				0.88	1.2	11/1
SMALL-SIGNAL CHARACTERISTICS						A. I.
	1 1 1 1		0.00			NAU-
Current-Gain — Bandwidth Product	MD22EO A AE	fT		600		MHz
$(I_C = 10 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz})$	MD3250,A,AF	Links and the second second	200	600		1
	MD3251,A,F,AF MQ3251		250 300	600		1
HILDON AND Y HELD	11103201		300			
Output Capacitance		Cobo	T	2.5	6.0	pF
$(V_{CB} = 5.0 \text{ Vdc}, I_{E} = 0, f = 100 \text{ kHz})$						
nput Capacitance		Cibo	Au 001 - 21	6.0	8.0	pF
$(V_{BE} = 1.0 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$			Autoria - Ja			
MATCHING CHARACTERISTICS (MD3250,A,AF & I	MD3251,A,F,AF ONLY)					
DC Current Gain Ratio(3)	2.0 1.0	hees/hees	81 .03	0.5 0.5	12	5.0 _1.0
(IC = $100 \mu Adc$, VCE = 5.0 Vdc)		hFE1/hFE2	0.9	EMBURNET 1	1.0	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$			0.9	FEBRUARY, I	1.0	
			0.5	_	1.0	
Base-Emitter Voltage Differential		V _{BE1} -V _{BE2}				mVdc
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$		a andere	_	_	3.0	
$(I_C = 10 \mu\text{Adc}, V_{CE} = 5.0 \text{Vdc})$		2001 - 2 1 1 1			5.0	
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	The state of the s		-		5.0	
Base-Emitter Voltage Differential Change Due to To		Δ V _{BE1} /V _{BE2}			-	mVdc
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_A = -55 \ to + 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc$	- 25°C)			-	0.8	
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_A = +25 \ to + 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, T_{A} = +25 \ to + 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, V_$	- 125°C)	2000		-	1.0	
Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤	2.0%.					
The lowest hee reading is taken as hee1 for this	ratio.					











MAXIMUM RATINGS

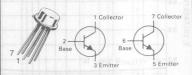
Rating	Symbol	Va	lue	Unit
Collector-Emitter Voltage	VCEO	3	0	Vdc
Collector-Base Voltage	VCBO	6	0	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	80 5	00	mAdc
350 to 355	(ha)\$3V tal 3	One Die	Both Die Equal Power	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	575 3.29	625 3.57	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 10.3	2.5 14.3	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to	0 +200	°C

THERMAL CHARACTERISTICS

Characteristic 43 844 834	Symbol	One Die	Both Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	97	70	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	304	280	°C/W
		Junction to Ambient	Junction to Case	
Coupling Factors		84	44	%

MD3409 MD3410

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MD2218 for graphs.

(1) $R_{\theta \rm JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 10 μAdc, I _B = 0)	V(BR)CEO	30			Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	60	W	144-12	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	5.0			Vdc
Collector Cutoff Current ($V_{CB} = 50 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 50 \text{ Vdc}$, $I_E = 0$, $T_{A} = 150^{\circ}\text{C}$)	СВО		0 -50	10 10	nAdc μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	IEBO	IAmi TV3	HRUD REAR	10	nAdc
ON CHARACTERISTICS					
DC Current Gain(2) ($I_{\rm C} = 10 \ \mu {\rm Adc}, V_{\rm CE} = 10 \ {\rm Vdc})$ ($I_{\rm C} = 100 \ \mu {\rm Adc}, V_{\rm CE} = 10 \ {\rm Vdc})$ Both Devices ($I_{\rm C} = 1.0 \ {\rm mAdc}, V_{\rm CE} = 10 \ {\rm Vdc})$ Both Devices ($I_{\rm C} = 10 \ {\rm mAdc}, V_{\rm CE} = 10 \ {\rm Vdc})$ Both Devices	hFE	20 30 40 50	40 50 60 65	100 120 160 200	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)	-	0.09	0.15	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}	-	0.7	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	200	250		MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)	Cobo		3.5	8.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1.0 MHz)	Cibo		15	25	pF
MATCHING CHARACTERISTICS					
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	VBE1-VBE2	=		1.6 0.8 2.0 1.0	mVdc

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Collector-Base Voltage		VCBO	symbe	40	Vdc
Emitter-Base Voltage		VEBO	5.0		Vdc
Collector Current — Cont	inuous	Ic	3-14	1.5	Adc
oby ob	0.32	- 1	One Die	All Die Equal Power	
Total Device Dissipation @ TA = 25°C	0.95	PD	VeE(set)		mW
MD3467 MQ3467			600 400	650 600	
Derate above 25°C MD3467 MQ3467		180	3.42	3.7 3.42	mW/°C
Total Device Dissipation	5.0	PD	000	0.42	Watts
@ T _C = 25°C MD3467 MQ3467			2.1	3.0 4.0	
Derate above 25°C					mW/°C
MD3467 MQ3467			12 5.71	17.2 22.8	Vac
Operating and Storage J Temperature Range	unction	T _J , T _{stg}	-6	5 to +200	°C

MD3467 MQ3467

MD3467 CASE 654-07, STYLE 1



MQ3467 CASE 607-04, STYLE 1



DUAL
AMPLIFIER TRANSISTOR
PNP SILICON

THERMAL CHARACTERISTICS

Characteris	stic	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	R_{θ} JC	83.3 175	58.3 43.8	°C/W	
Thermal Resistance, Junction to Ambient	MD3467 MQ3467	R _θ JA(1)	292 438	270 292	°C/W
Au Use Au Observation	OUT AN US-31		Junction to Ambient	Junction to Case	
Coupling Factors	MD3467 MQ3467 (Q1-Q2) (Q1-Q3 or Q1-Q4)		85 57 55	40 0 0	%

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

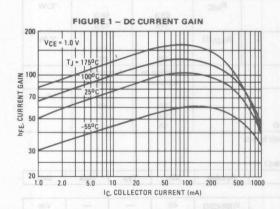
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

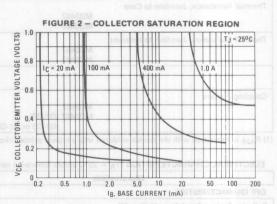
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	1/4	e) telaninus	нотовилов,	31	
Collector-Emitter Breakdown Voltage(2) $(I_C = 10 \text{ mAdc}, I_B = 0)$	V(BR)CEO	40	T	-	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	40	-	-	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	5.0	MO - ES	70.014	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0, T _A = 100°C)	Ісво			10	μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	IEBO			100	nAdo

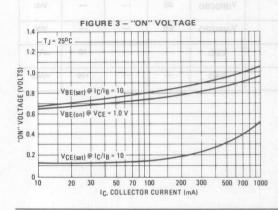
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

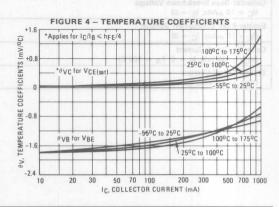
	Characteristic		.03.	Symbol	Min	Тур	Max	Unit
ON CHARACTERISTICS	16k H 7 h	whi.	8.4		and the		and the last	G continu
DC Current Gain (I _C = 500 mAdc, V _{CE} =	1.0 Vdc)		aı	hFE	20	apopultu	O - marin	U rotselle
Collector-Emitter Saturation (I _C = 500 mAdc, I _B = 50			Ail Die Equal Poyate	V _{CE} (sat)	-	0.32	0.5	Vdc
Base-Emitter Saturation Vo		33/13	nan	V _{BE(sat)}	- PD	0.95	1.2	Vdc
SMALL-SIGNAL CHARACT	ERISTICS		005	008			1	SI-EDM
Current-Gain — Bandwidth (IC = 50 mAdc, VCE = 1		3°W/m	3.2	f _T	150	220	78°C	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f	= 140 kHz)	enew	S.P.E.	C _{obo}	an -	8.5	20	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0,	f = 140 kHz)		3.0	Cibo	-	22	80	pF
SWITCHING CHARACTERIS	STICS							Dereto st
Delay Time	(VCC = 30 Vdc, VBE = 2	2.0 Vdc,	22.8	td	_	7.0	10	ns
Rise Time	$I_C = 500 \text{ mAdc}, I_{B1} = 500 \text{ mAdc}$	0 mAdc)	0.85	t _r	x 7	17	30	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 50	0 mAdc,		ts	10-10	58	80	ns
Fall Time	$I_{B1} = I_{B2} = 50 \text{ mAdc}$			tf	-	14	30	ns

(2) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

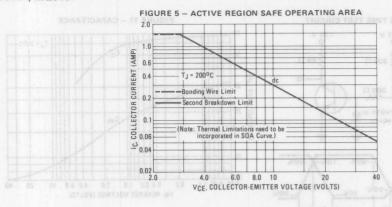


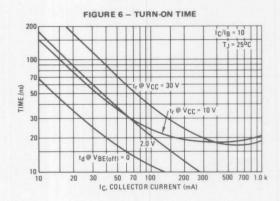


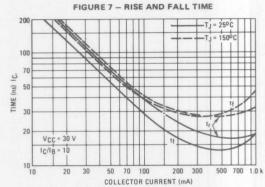


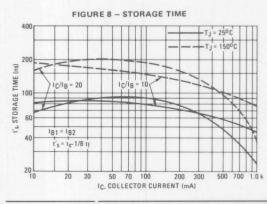


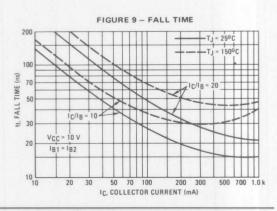




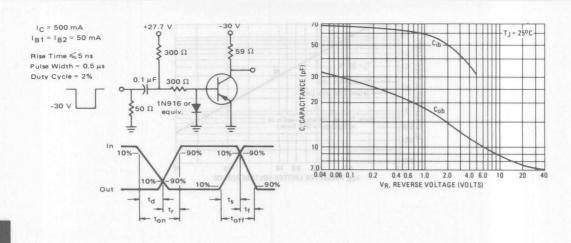


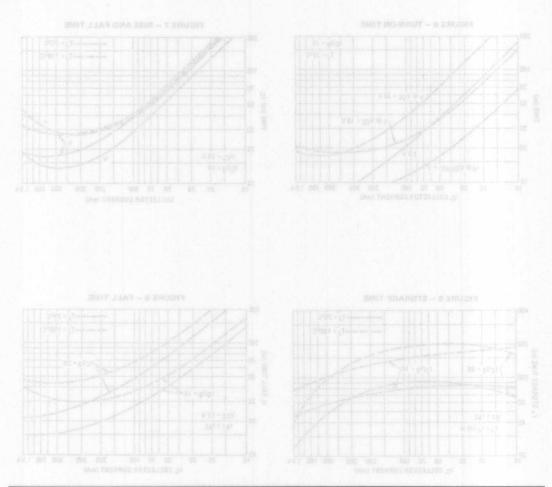






MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





Collector-Base Voltage		VCBO		65	Vdc
Emitter-Base Voltage		VEBO	6.0		Vdc
Collector Current — Cont	inuous	Ic		1.0	Adc
ably	- 1	30	One Die	All Die Equal Power	
	0.19	PD	One Die	Equality	mW
MD3725 MD3725F MQ3725		08.0	600 350 400	650 400 600	
Derate above 25°C MD3725 MD3725F		200	3.42	3.7 2.28	mW/°0
MQ3725 Total Device Dissipation	-	PD	2.28	3.42	Watts
@ T _C = 25°C MD3725 MD3725F MO3725			2.1 1.25 1.0	3.0 2.5 4.0	
Derate above 25°C			12	17.2	mW/°(
MD3725 MD3725F MQ3725			7.15 5.71	14.3	(Ho)3
Operating and Storage Ju Temperature Range	unction	TJ, Tstg	-65	to +200	°C



THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	All Die Equal Power	Unit	
Thermal Resistance, Junction to Case	MD3725 MD3725F MQ3725	R _B JC	83.3 140 175	58.3 70 43.8	°C/W
Thermal Resistance, Junction to Ambient	MD3725 MD3725F MQ3725	R _θ JA(1)	292 500 433	270 438 292	°C/W
			Junction to Ambient	Junction to Case	00
Coupling Factor	MD3725 MD3725F MQ3725 (Q1-0	02) 03. Q1-Q4)	85 75 57 55	40 0 0	%

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

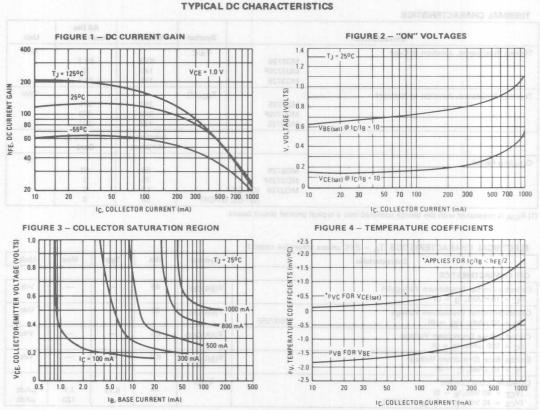
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Search and the Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					111 0.4
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, I _B = 0)	V(BR)CEO	40		1-1	Vdc
Collector-Emitter Breakdown Voltage (I _C = 10 µAdc, V _{BE} = 0) MD3725F	V(BR)CES	65			Vdc
Collector-Base Breakdown Voltage (IC = 100 µAdc, IE = 0)	V(BR)CBO	65			Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	6.0	7	- 10 - 11	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0) (V _{CB} = 40 Vdc, I _E = 0, T _A = 100°C)	ІСВО	E BY	0.12	1.7	μAdc μAdc

ELECTRICAL	CHARACTERICTICS	(- · · · - · ·) (T	2500	and an art and a maked \
ELECTRICAL	CHARACTERISTICS	(continued) (IA	= 25°C	unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
ON CHARACTERISTICS(2)	303	60		0807		Eguton ass	G- (11281)0J
DC Current Gain	DDA	0.0	hFE	083V		sdigues at	st-18/7/m3
$(I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$				50	appunitno	150	Coffeetor C
$(I_C = 500 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc})$		eld BA		30	_	_	
Collector-Emitter Saturation Voltage			VCE(sat)				Vdc
(I _C = 100 mAdc, I _B = 10 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)				99 I	0.19 0.30	0.26 0.45	Total Devic
Base-Emitter Saturation Voltage		088	VBE(sat)			725	Vdc
(I _C = 100 mAdc, I _B = 10 mAdc)			380	+	_	0.86	EQ M
$(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$		908	-008	0.80	_	1.2	
SMALL-SIGNAL CHARACTERISTICS							
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)		2.28	2.2 f _T	200	-	725	MHz
Output Capacitance (VCB = 10 Vdc, IE = 0, f = 100 kHz)	Warte		C _{obo}	99 +	- nc	10	pF pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)		3.0	C _{ibo}	-	-	65	pF
SWITCHING CHARACTERISTICS			W.I				Detab. 2
Turn-On Time (V _{CC} = 30 Vdc, I _C = 500 mAdc, I _{B1} = 50 mAdc	, V _{BE(off)}	= 3.8 Vdc)	Sf ton	+	20	45	
Turn-Off Time (V _{CC} = 30 Vdc, I _C = 500 mAdc, I _{B1} = I _{B2} = 50	mAde)	22.6	toff	Tur Tes	50	75	ns

(2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 5 - CURRENT-GAIN - BANDWIDTH PRODUCT

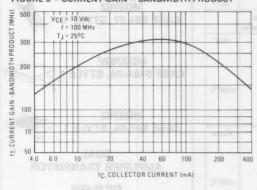


FIGURE 6 - CAPACITANCE

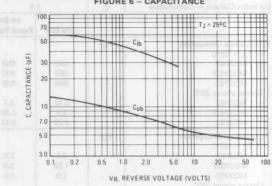


FIGURE 7 - TURN-ON TIME

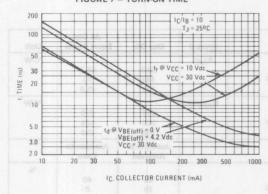


FIGURE 8 - TURN-OFF TIME

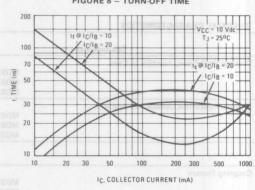


FIGURE 9 - SWITCHING TIME TEST CIRCUIT

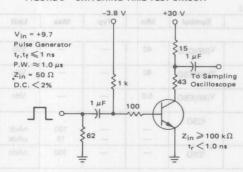
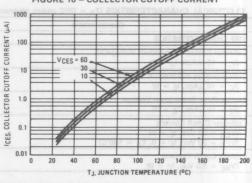


FIGURE 10 - COLLECTOR CUTOFF CURRENT



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Emitter-Base Voltage	VEBO		5.0	Vdc
Collector Current — Continuous	Ic		Adc	
0986 - 11		One Die	All Die Equal Power	
Total Device Dissipation	PD			mW
@ $T_A = 25^{\circ}C$				
MD3762		600	650	1
MD3762F		350	400	7
MQ3762	E HELLER	400	600	
Derate above 25°C			8 7	mW/°C
MD3762		3.42	3.7	
MD3762F		2.0	2.28	1
MQ3762		2.28	3.42	
Total Device Dissipation	PD		-	Watts
@ $T_C = 25^{\circ}C$				
MD3762		2.1	3.0	
MD3762F	3.1 2.0	1.25	2.5	280
MQ3762	V98.39	1.0	4.0	
Derate above 25°C				mW/°C
MD3762	5 0	12	17.2	
MD3762F		7.15	14.3	5 - St -
MQ3762		5.71	22.8	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65	to +200	°C

MD3762
CASE 654-07, STYLE 1

MD3762F
CASE 610A-04, STYLE 1

MQ3762
CASE 607-04, STYLE 1

DUAL
AMPLIFIER TRANSISTOR

PNP SILICON

THERMAL CHARACTERISTICS

Characteristic			Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	MD3762 MD3762F MQ3762		R _θ JC	83.3 140 175	58.3 70 43.8	°C/W
Thermal Resistance, Junction to Ambient	MD3762 MD3762F MQ3762		R _θ JA(1)	292 500 438	270 438 292	°C/W
gon say our ppr not or at as at			u dai no	Junction to Ambient	Junction to Case	308
Coupling Factors		Q1-Q2) Q1-Q3, Q	14 _m T ₁	85 75 57 55	40 0 0	%

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				3.7	- = GIV
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, IB = 0)	V(BR)CEO	40	-	5/3078/46/68 5/3	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	V(BR)CBO	40	1-	- n t	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	74) 1	II –	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0) (V _{CB} = 30 Vdc, I _E = 0, T _A = 100°C)	ICBO	1	_ sa:	100 10	nAdc μAdc
Emitter Cutoff Current (V _{BE} = 3.0 Vdc, I _C = 0)	IEBO	-		100	nAdc

Characteristic			Min	Тур	Max	Unit
ON CHARACTERIST	TICS(2)					
DC Current Gain (I _C = 1.0 Adc, V _C)	= 2.0 Vdc)	hFE	20	40	-	-
Collector-Emitter Saturation Voltage (I _C = 1.0 Adc, I _B = 0.1 Adc)		V _{CE} (sat)	G 0,2	0.52	1.0	Vdc
Base-Emitter Saturation Voltage (I _C = 1.0 Adc, I _B = 0.1 Adc)		V _{BE(sat)}	18 2	1.05	1.4	Vdc
SMALL-SIGNAL CH	ARACTERISTICS		20.0 3			
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)		fT	150	220	_	MHz
Output Capacitance (VcR = 10 Vdc, IF = 0, f = 140 kHz)		C _{obo}	2.0	8.5	20	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 140 kHz)		C _{ibo}	SMIT NO-	22	80	pF
SWITCHING CHARA	ACTERISTICS	Bi = anal		HILL		
Delay Time	(V _{CC} = 30 Vdc, V _{BE(off)} = 2.0 Vdc,	td		5.0	10	ns
Rise Time	I _C = 1.0 Adc, I _{B1} = 100 mAdc)	t _r		18	30	ns
Storage Time	(V _{CC} = 30 Vdc, I _C = 1.0 Adc,	ts		45	80	ns
Fall Time	$I_{B1} = I_{B2} = 100 \text{ mAdc}$	tf	1 1 1	18	30	ns

⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

FIGURE 1 - DC CURRENT GAIN

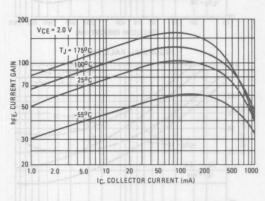


FIGURE 3 - "ON" VOLTAGE

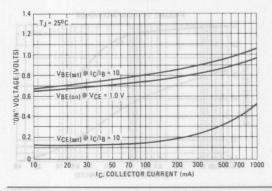


FIGURE 2 - COLLECTOR SATURATION REGION

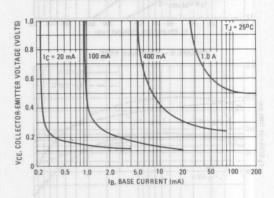
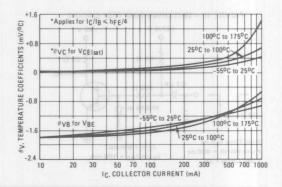
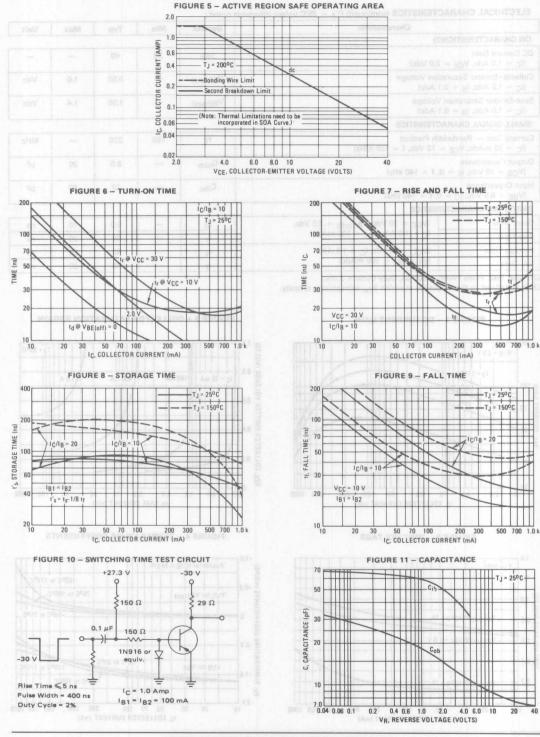


FIGURE 4 - TEMPERATURE COEFFICIENTS



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

⁽³⁾ fT is defined as the frequency at which |hfe| extrapolates to unity.



MAXIMUM RATINGS

Rating	Symbol	Value		Unit		
Collector-Emitter Voltage	VCEO	1	2	Vdc		
Collector-Base Voltage	VCBO	1	2	Vdc		
Emitter-Base Voltage	VEBO	4.0		4.0		Vdc
Collector Current — Continuous	Ic	5	50	mAdc		
		One Die	Both Die			
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	550 3.14	600 3.42	mW mW/°C		
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.4	2.0 11.4	Watts mW/°C		
Operating and Storage Junction Temperature Range	T _J , T _{stg}	aby-65 to		°C		

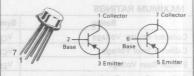
THERMAL CHARACTERISTICS

Characteristic	Junction to Ambient	Junction to Case	Unit
Thermal Resistance	700	000	°C/W
One Die	319	125	
Effective, Both Die	292	87.5	
Coupling Factor	83	40	%

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

MD4260 MD4261

CASE 654-07, STYLE 1



DUAL RF AMPLIFIER

PNP SILICON

Refer to 2N4260 for graphs.

Max

1.0

10

200

Unit

Vdc Vdc Vdc

μAdc

nAdc

Characteristic	Symbol	Min
OFF CHARACTERISTICS	age (lc = 3.0 mAde, la = 0)	JaV nwa
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	12
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	V(BR)CBO	12
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	4.0
Collector Cutoff Current (V _{CE} = 12 Vdc, I _B = 0)	(3 Dat = A7 0 = ICEO V at	* 80 <u>M</u>
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)	Ісво	_
ON CHARACTERISTICS 08 09 394	c, VCE = 1.0 Vdct	3.0 mAd
DC Current Gain (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 30 mAdc, V _{CE}	= 2.0 Vdc) hFE	10V 30
de) Veteran - 1.0 Vde	(lc = 10 mAdc, lg = 1.0 mA	20

V = V = V = V = V = V = V = V = V = V =	(1c = 10 mAdc.)	908.40V no	ter baturati	Base-Emil
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{CE(sat)}	RACTERIST	0.3	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE} (sat)	width Prod	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS			ů mAde, Vç	h = 50
Current-Gain — Bandwidth Product (IC = 0.5 mAdc, V_{CE} = 4.0 Vdc, f = 100 MHz) (IC = 10 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	ft (sHxl 0	1.0	pacitance 10 Vdc, Ig	GHz
Output Capacitance (V _{CB} = 3.0 Vdc, I _E = 0, f = 100 kHz)	Cobo	-	2.5	qs0 pFqm
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 100 kHz)	Cibo	1 = 1,0 =	2.5	pF
Collector Base Time Constant ($I_C = 5.0$ mAdc, $V_{CE} = 4.0$ Vdc, $f = 31.8$ MHz) ($I_C = 10$ mAdc, $V_{CE} = 10$ Vdc, $f = 31.8$ MHz)	A shirb'Cc = 1 s	5V 0.0 = 3	35 30	ps

MATCHING CHARACTERISTICS (MD4261 only)

hFE1/hFE2	0.8	1.0	0.8 = 0.0
V _{BE1} -V _{BE2}	(1)	10	mVdc
		Bournelle - Ju - Su district	Parametra santa

(1) The lowest hee reading is taken as hee1 for this ratio.

MD4261

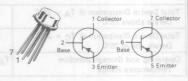
CASE SEA OF STVIE

MAXIMUM RATINGS

WAXIIIOW IIX IIICO				95 1 - 54
Rating	Symbol	anavy Va	lue	Unit
Collector-Emitter Voltage	VCEO	27/Wm 15 FF		Vdc
Collector-Base Voltage	VCBO	201034 916		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current Continuous	Ic	5	0	mAdc
RF AMPLIFIER		One Side	Both Sides	ot i
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.7	400 2.3	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	+ 200	°C

ווועטטטטותוט

CASE 654-07, STYLE 1



AMPLIFIER TRANSISTOR

PNP SILICON stales 4 lorment

Refer to 2N3307 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS		olistio	Charac			
Collector-Emitter Breakdown Voltage (I _C = 3.0 mAdc, I _B	= 0)	V(BR)CEO	15	83	MCTERIST	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc$, $I_E = 0$)	V(BR)CBO	20	kdo <u>w</u> a Val	mitt <u>er</u> Brei	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)		V(BR)EBO	5.0	own_Volta	lase <u>B</u> reakd	Vdc
Collector Cutoff Current $(V_{CB} = 15 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 15 \text{ Vdc}, I_{E} = 0, T_{A} = 15 \text{ Vdc})$	0°C)	СВО	(l <u>g =</u> 10 12 VI Ic, lg	wn <u>Vo</u> ltage nt (V CE =	0.010	μAdc
ON CHARACTERISTICS		10 = 9	i 10 Vdc, lg	goV) in	utoff Curre	Collector C
DC Current Gain (I _C = 3.0 mAdc, V _{CE} = 1.0 Vdc)		hFE	-20	50 83	ACTERISTIC	RAHS-MO
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IB =	1.0 mAdc)	VCE(sat)	r = J oV .e	biArn -0 1 =	0401	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0	mAdc)	VBE(sat)		_	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	(abAm 0.	10 mAdc, lg = 1	= Oll age	ration Volt	mitter Satu	Collector
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	Aulc)	mAdc. In 1.0 m	600		er S <u>at</u> urati GNAL CHA	MHz
	4.0 Vdc, f = 100 10 Vdc, f = 100 I	= 30 Cobo m 8.0	= 3 - 101 = 3 -	bos ^s Hrbiw	bns:1.7- m	D-mpF _m C
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 140 kHz)		Cibo = 1.0	Vda , j g = 0	(VCB - 3.0	ec 2.0 cec	ou Aqui Ca
Noise Figure (I _C = 1.0 mAdc, V_{CE} = 6.0 Vdc, f = 60 MHz, R _S = 400	ohms)	Ne. Vos = 4.6 V	$c = \frac{5.0 \text{m}}{10.00}$	30	6.0 ami	dB
FUNCTIONAL TEST	111111111111111111111111111111111111111	Julia	e racurinal	antreisen	O CHARAC	UNITEM
Amplifier Power Gain (I _C = 6.0 mAdc, V_{CB} = 12 Vdc, R_{G} = R_{L} = 50 ohms, f	= 200 MHz)	G _{pe}	15	20 (1)	Gain Ratio	dB
MATCHING CHARACTERISTICS				Differential	onethyl re	mro 3.ess 5
DC Current Gain Ratio(1)		hFE1/hFE2	+	bV 0.1 = ;	mAde, Ve	() (= -
$(I_C = 4.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD5000 MD5000A MD5000B	or this ratio.	0.9	ing 15 take	1.0 1.0	The lowe
Base-Emitter Voltage Differential (I _C = 4.0 mAdc, V _{CE} = 10 Vdc)	MD5000 MD5000A MD5000B	VBE1-VBE2		5.0 — —	5.0 10	mVdc
Base-Emitter Voltage Differential Gradient (IC = 4.0 mAdc, V_{CE} = 10 Vdc_{y} T_{A} = -55 to $+125$ °C)	MD5000 MD5000A MD5000B	$\frac{\Delta(V_{BE1}-V_{BE2})}{\Delta T_{A}}$	Ξ	10 		μV/°C

(1) The lowest hee reading is taken as hee1 for this ratio.

Collector-Emitter Voltage		VCEO	3	30	Vdc
Collector-Base Voltage	-	VCBO	50	60	Vdc
Emitter-Base Voltage		VEBO	5	5.0	Vdc
Collector Current — Continuous		IC	5	00	mAdc
An 00f -		0.0	One Die	All Die Equal Power	
Total Device Dissipation @ TA = 2	5°C	PD			mW
MD6001,2,3		- 3	575	625	
MD6001F,2F			350	400	NOBON
MQ6001,2			400	600	MQqsea
Derate above 25°C					
MD6001,2,3		1.1	3.29	3.57	mW/°C
MD6001F,2F			2.0	2.28	40.663
MQ6001,2			2.28	3.42	M08002
Total Device Dissipation @ T _C = 2	5°C	PD			Watts
MD6001,2,3		1.17	1.8	2.5	MOROUZ
MD6001F,2F			1.0	2.0	
MQ6001,2			0.9	3.6	гозвом
Derate above 25°C					mW/°C
MD6001,2,3			10.3	14.3	RODROM
MD6001F,2F			5.71	11.4	
MQ6001,2			5.13	20.5	19080M
Operating and Storage Junction	Œ	TJ, T _{stg}	- 65 to	0 +200	°C

MD6003 MQ6001, MQ6002 MD6002 MD6003 CASE 654-07, STYLE 5

MD6001F MD6002F

CASE 610A-04, STYLE 1

MQ6001 MQ6002 CASE 607-04, STYLE 1

COMPLEMENTARY DUAL
GENERAL PURPOSE
TRANSISTOR
NPN/PNP SILICON

THERMAL CHARACTERISTICS

THENWAL CHANA	OILMOIN	10			All Davides	(abAm	mAde la = 15	150 = 150
		Characteristic	Vactoria	6002,F, MQ6002,1	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance,	Junction to	Case	MD6001,2,3		R _O JC	97 (slaAm		
			MD6001F,2F MQ6001,2		cle ≤ 2.0%.	175 195	87.5 48.8	teeT gelu
Thermal Resistance,	Junction to	Ambient	MD6001,2,3 MD6001F,2F MQ6001,2		R _θ J _A (1)	304 500 438	280 438 292	°C/W
			MIAD THE	anguo po - f	RIGURI	Junction to Ambient	Junction to Class	
Coupling Factor			MD6001,2,3			84	44	%
		HATE	MD6001F,2F MQ6001,2 (Q	11-Q2) 11-Q3 or Q1-Q4)		75 57 55	0 0	

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic		Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)		30	-		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0) MD6003 MD6001,F, MD6002,F, MQ6001, MQ6002		50 08 30	_	02-1	Vdc 3.0
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	5.0	-	-	Vdc
Base Cutoff Current (V _{CE} = 30 Vdc, V _{BE} = 3.0 Vdc) (V _{CE} = 50 Vdc, V _{EB} = 3.0 Vdc) MD6003 MD6001,F,2,F, MQ6002,F	IBEV	=	=	50 30	nAdc

Characteri	stic			Symbol	Min	Тур	Max	Unit
Collector Cutoff Current	oloV	V	30	ICEV		age	initter Valt	3-totoelli
$(V_{CF} = 30 \text{ Vdc}, V_{BE(off)} = 3.0 \text{ Vdc})$ MD6003				VCBO 50	_	_ 9	30 928	nAdd
$(V_{CE} = 50 \text{ Vdc}, V_{EB(off)} = 3.0 \text{ Vdc})$ MD60	MD6001,F,2,F, I MD6001,F,2,F, I		600	Veso Ic	-	ontinuous	30	nAdd μAdd
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0)	MD6003,F	VII Die Equal		ICBO	-	-	100	nA

ON CHARACTERISTICS(2)

ON CHARACTERISTICS(2)								
DC Current Gain $(I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD6001,F, MQ6001 MD6002,F, MQ6002	625 400 800	576 350 400	hFE	20 35	80 70	01F,2F 01,2 =	
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD6001,F, MQ6001 MD6003 MQ6002,F, MQ6002	2.28			25 40 50	90 70 100	DOVE 25°C 01,2,3 01F,2F 01,2	
(I _C = 10 mAdc, V _{CE} = 10 Vdc)	MD6001,F, MQ6001 MD6002,F, MQ6002			g9	35 75	70 110	01,2:3 01F,2F	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD6001,F, MQ6001 MD6003 MD6002,F, MQ6002	14.3			40 70 100	110 200	120 — 300	
(I _C = 300 mAdc, V_{CE} = 10 Vdc)	MD6001,F, MQ6001 All Other Devices			ptaT .IT	20	_ noi 90 ut s	01,2 and St orag	
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MD6001,F, MQ6001 MD6002,F, MQ6002				20 50	80	ture Range	
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)	All Devices MD6001, MD6002,F, I	MQ6002,1	VC	CE(sat)	_ 8	0.3 0.59	0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)	All Devices MD6001, MD6002,F, I	MQ6001,2 ε	9V	BE(sat)	Characte Case—	1.02	2.0	Vdc Hammer

(2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

2.0

1.0

TJ = +175°C +25°C-

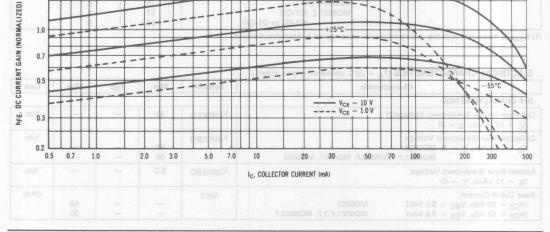
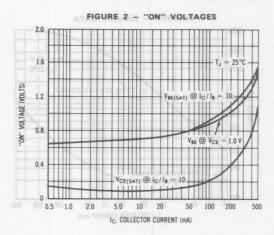
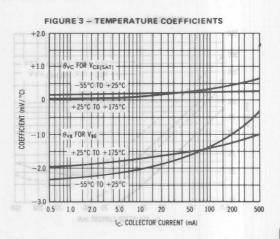
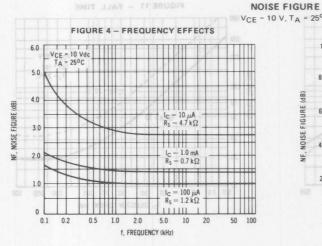
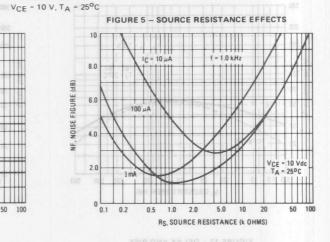


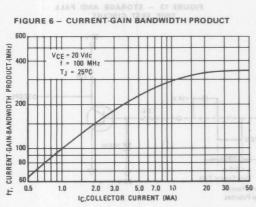
FIGURE 1 - DC CURRENT GAIN

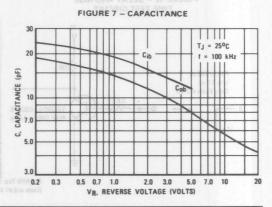




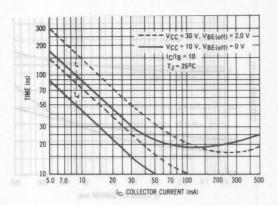


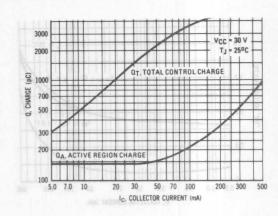














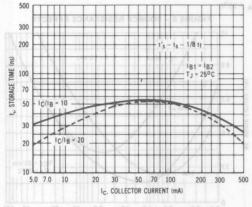


FIGURE 11 - FALL TIME

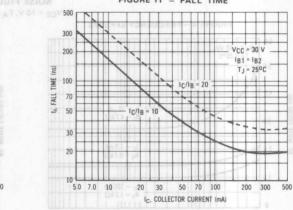


FIGURE 12 - DELAY AND RISE

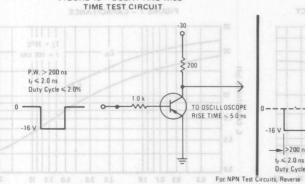
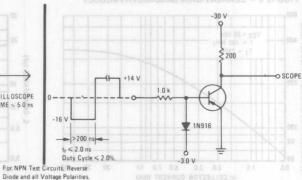


FIGURE 13 - STORAGE AND FALL TIME TEST CIRCUIT



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

	1			1
Collector-Base Voltage	VCBO	500 5	0 08	Vdc
Emitter-Base Voltage	VEBO	50V 5.	0.8	Vdc
Collector Current — Continuous	Ic	50	00 008	mAdc
554-07, STYLE 1 - 7977	CASE	One Die	Both Die	One Die
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	575 3.29	625 3.57	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	0 3 Pp O	1.8 10.3	2.5 14.3	Watts mW/°0
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	+ 200	85.°C
107-04, STYLE 1 - 254 B-	CASE		8.8	2.1

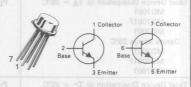
THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	Both Die	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	97	2.70	°C/W
Thermal Resistance, Junction to Ambient	R _θ JA(1)	304	280	°C/W
		Junction to Ambient	Junction to Case	
Coupling Factor		84	44	%

(1) R_{BJA} is measured with the device soldered into a typical printed circuit board.

MD7000

CASE 654-07, STYLE 1



DUAL GENERAL PURPOSE TRANSISTOR

NPN SILICON PRODUCT

Refer to MD2218 for graphs.

ELECTRICAL	CHARACTERISTIC	S (TA	=	25°C unless	otherwise	noted.)

W/O _c	Characterist	Rauc oit		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	140		100/100					
Collector-Emitter Breakdown (IC = 10 mAdc, IB = 0)	Voltage(2)		AQ7601	V(BR)CEO	30	_	-	Vdc
Collector-Base Breakdown Vo	ltage 82	RajA(1)	ND7001 AD7001F		50	ol noilanu	seletanes, .	Vdc
Emitter-Base Breakdown Volt (I _E = 10 μAdc, I _C = 0)	age Oliverity		AQ7601	V(BR)EBO	5.0	-	-	Vdc
Collector Cutoff Current (VCB = 40 Vdc, IF = 0)	Ambiana			СВО	-		100	nAdc
ON CHARACTERISTICS	88		1007.001					
DC Current Gain(2) (IC = 1.0 mAdc, VCE = 10		or Q1-Q4)	007001 (Q1-Q2 (Q1-Q3		40 70	60 80	-1	-
(I _C = 150 mAdc, V _{CE} = 10 Vdc) (I _C = 300 mAdc, V _{CE} = 10 Vdc)				into a typical pri	30	50	neas <u>ur</u> ed w	Rala is
Collector-Emitter Saturation \((IC = 150 mAdc, IB = 15 m			(.beton ealw	VCE(sat)	e ATI BOT	0.2 ACTERIST	0.4 FAHO 1AC	Vdc
Base-Emitter Saturation Volta (IC = 150 mAdc, IB = 15 m		Symbol		V _{BE} (sat)	Thar—teristi	0.95	1.3	Vdc
SMALL-SIGNAL CHARACTER	RISTICS OF	ОчиванУ			age(2)	faV nwoba	mitter Break	Haptoslie 3
Current-Gain — Bandwidth P (IC = 20 mAdc, VCE = 20		lHz)		fT	200		mA de , Ig asa Breakd	-
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f =		OSSISSIV		C _{obo}	_	3.5	8.0	
Input Capacitance (VFB = 2.0 Vdc, I _C = 0, f =	= 100 kHz)	agal		C _{ibo}	-	15 (0		r pF

(2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

 OC Current Gain.
 hpE
 40
 50

 (IC = 1.0 mAds, VCE = 10 Vdc).
 70
 90

 (IC = 350 mAds, VCE = 10 Vdc).
 30
 60

 (IC = 300 mAds, VCE = 10 Vdc).
 30
 60

 (IC = 150 mAds, VCE = 10 Vdc).
 0.25
 0.25

Rating	Symbol	Mints 1	Value	Unit
Collector-Emitter Voltage	VCEO	yde	30	Vdc
Collector-Base Voltage	VCBO	obV	50	Vdc
Emitter-Base Voltage	VEBO	SBV	5.0	Vdc
Collector Current — Continuous	Ic		600	mAdc
CASE SEA-07 STYLE 1		One Di	e All Die	niti ne
Total Device Dissipation @ T _A = 25°C MD7001 MD7001F MQ7001 Derate above 25°C MD7001 MD7001F MQ7001F MQ7001	PD	600 350 400 3.42 2.0 2.28	650 400 600 3.7 2.28 3.42	mW
Total Device Dissipation @ T _C = 25°C MD7001 MD7001F MQ7001 Derate above 25°C MD7001 MD7001F MQ7001F MQ7001	PD	2.1 1.25 1.0 12 7.15 5.71	3.8 2.5 4.0 17.2 14.3 22.8	mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65	5 to +200	°C

MD7001,F MQ7001

MD7001 CASE 654-07, STYLE 1



MD7001F CASE 610A-04, STYLE 1



MQ7001 CASE 607-04, STYLE 1



DUAL AMPLIFIER TRANSISTOR

PNP SILICON

THERMAL CHARACTERISTICS

Characteristic					(.beton entwento	Symbol	One Die	All Die Equal Power	Unit
Thermal I	Resistance, J	lunction to	Case		MD7001 MD7001F	R _⊕ JC al	83.3 140	58.3	W\O°
					MQ7001		(\$175 HbV	43.8	
Thermal I	Resistance, J	lunction to	Ambient 00	V(BR)CBO	MD7001 MD7001F MQ7001	R _θ JA(1)	292 500 438	270 B 98 438 BA 292	of octools (if = 3i)
ob/Ara	100			nent			Junction to Ambient	Junction to Case	, Uf = g() ∠ notsello
Coupling	Factor				MD7001 MD7001F		85 75	O Vdc. lg == 0)	IV% = 4
					MQ7001 (Q1-Q2)	or Q1-Q4)	57 55 ODV 0		

⁽¹⁾ R_{BJA} is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (TA - 25 C unless otherwise	o noted.,	A	DRWRITCH	BI DUAM U	
bbV E./ 88.0 Characteristic (heal agV	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			= 15 mAdo	gl.,obAm 0	116 = 115
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, IB = 0) 88	V(BR)CEO	30	ACTERISTA Vidth Produc	GNAL_CHAN	Vdc
Collector-Base Breakdown Voltage (IC = 10 µAdc, IE = 0)	V(BR)CBO	50	= 2 <u>0</u> Vdd	mAde, Vor pacitance	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	5.0	0), <u>1.</u> = 100	10 V <u>dc</u> lg	Vdc
Collector Cutoff Current (V _{CB} = 40 Vdc, I _E = 0)	OBO S 2.0%) kH <u>irl</u> s, Duty Ol		2.0 001 10 st. Pulse W	nAdc
ON CHARACTERISTICS(2)					
DC Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 150 mAdc, V _{CE} = 10 Vdc) (I _C = 300 mAdc, V _{CE} = 10 Vdc)	hFE	40 70 30	50 90 60	=	-
Collector-Emitter Saturation Voltage (Ic = 150 mAdc, Ip = 15 mAdc)	V _{CE} (sat)	-	0.25	0.4	Vdc

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

	- 03	Symbol	Min	Тур	Max	Unit
		V _{BE(sat)}	NEW -	0.88	pgs/1.3 sec	Vdc
obAm	30		4	leugunitan'	- Inemi	L'allector.
	Equal Power	did endT	200	320	feralesifi en	MHz
Win	625	C _{obo}	1 +	5.8	8.0	ATPF
Watts	2.5	Cibo	da +	16 AO	30	veC pFoT
	abV abV abA	5.0 Vdc 30 mAdc 30 Equal Power 625 mW 3.57 mW/rC	Symbol VBE(sat) O Cobo Cibo	Symbol Min VBE(sat) Cobo Cibo	Symbol Min Typ	Symbol Min Typ Max

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

DUAL

AMPLIFIER TRANSISTOR

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

	se-Emitter Saturation Voltage (IC = 10 mAdc, Ig = 1.0 mAdc)			

2) Pulse Test: Pulse Width = 300 µs, Duty Cycin = 2.0%.
If The lowest her reading is taken as here; for this ratio.

Rating	Symbol	Value		Unit	
Collector-Emitter Voltage	VCEO	(Deldit sei	40	Vdc	
Collector-Base Voltage	VCBO	amás	50	Vdc	
Emitter-Base Voltage	VEBO	VBE(sa	5.0	Vdc	
Collector Current — Continuous	Ic		30		
320 MHz	200	One Die	Both Die Equal Power		
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	575 3.29	625 3.57	mW mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 10.3	2.5 14.3	Watts mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65	to +200	°C	

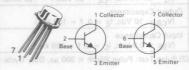
THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	Both Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	97	70	°C/W
Thermal Resistance, Junction to Ambient	R _θ JA(1)	304	280	°C/W
		Junction to Ambient	Junction to Case	04
Coupling Factors	84	44	%	

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit boa

MD7002,A,B

CASE 654-07, STYLE 1



DUAL **AMPLIFIER TRANSISTOR**

NPN SILICON

Refer to 2N2919 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40		_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	50	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	_	-	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	Ісво	_	_	100	nAdd
ON CHARACTERISTICS					
DC Current Gain(2) (I _C = 100 μ Adc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	hFE	40 50	130 170	=	-
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{CE} (sat)	_	0.2	0.35	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}	_	0.8	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (I _C = 5.0 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	200	260	_	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	9.5	2.6	6.0	pF
Input Capacitance (V _{BE} = 2.0 Vdc , I _C = 0 , f = 100 kHz)	Cibo	_	2.3	8.0	pF
MATCHING CHARACTERISTICS				STILL .	
DC Current Gain Ratio(3) $ (I_{\hbox{\scriptsize C}} = 100~\mu \hbox{\scriptsize Adc}, V_{\hbox{\scriptsize CE}} = 10~\hbox{\scriptsize Vdc}) \\ \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad $	hFE1/hFE2	0.75 0.85	=	1.0 1.0	-
Base-Emitter Voltage Differential (IC = 100 μ Adc, VCE = 10 Vdc) MD7002A MD7002B	V _{BE1} -V _{BE2}	=	_	25 15	mVdd

⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%. (3) The lowest hFE reading is taken as hFE1 for this ratio.

conscior-pase voltage	gyT	VCBO	Symbol	50	Vdc	CITATION TO THE CONTRACTOR
Emitter-Base Voltage	ac o	VEBO	Verminan	5.0	Vdc	- Tilly-Emitter Saturation Voltage
Collector Current — Con	ector Current — Continuous		(Ministration)	50	mAdc	MD7003,A,B = al.abAm
1.0 Vdo	0.6		One Die	All Die Equal Power		CASE 654-07, STYLE 1 182 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Total Device Dissipation		PD			mW	SWALL-SIGNAL CHARACTERISTICS
@ T _A = 25°C MD7003,A,B MD7003,AF		240	550 350	600 400		MD7003,AF CASE 610A-04, STYLE 1
Derate above 25°C	3.0		0 400	600	mW/°C	$V_{CB} = 100 \text{ dc}, I_{E} = 0, f = 100 \text{ kHz}$
MD7003,A,B MD7003,AF MQ7003		1	3.14 2.0 2.28	3.42 2.28 3.42		MQ7003 CASE 607-04, STYLE 1
Total Device Dissipation @ T _C = 25°C MD7003,A,B	0.5	PD	1.4	2.0	Watts	1c = 100 µAdc, Vcg = 10 Vdc, Rs = 3.0 xotvns 1 = 10 Hz to 15.7 MADD
MD7003,AF			0.7	1.4		AMPLIFIER TRANSISTOR
MQ7003 Derate above 25°C MD7003,A,B		0.75	0.7	2.8 9A. AE00	mW/°C	PNP SILICON DAY OUT = OI
MD7003,AF MQ7003			38V 4.0 4.0	8.0 16	SGM	Refer to 2N3810 for curves.
Operating and Storage J Temperature Range	lunction	TJ, T _{stg}	-65	to +200 BEDG	79/°C	

	COU INCIDE CHAPTER	di.
	MD7003,A,B = sl.abAm (
CASE	654-07, STYLE 1	
	SIGNAL CHARACTERISTICS	
	MD7003,AF	-Ine
CASE	610A-04, STYLE 1	
	$= 100/dc$, $I_{\rm E} = 0$, $f = 100$ kHz)	
	MQ7003	6
	607-04, STYLE 1	
	100 AAde, VCE = 10 Vde, RS = 10 Hz to 15.7 AAU	
,	DUAL AMPLIFIER TRANSISTOR	3
	PNP SILICON	
	Refer to 2N3810 for curves	

THERMAL CHARACTERISTICS

Characteristic		Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	MD7003,A,B MD7003,AF MQ7003	R _θ JC	125 250 250	87.5 125 62.6	°C/W
Thermal Resistance, Junction to Ambient	MD7003,A,B MD7003,AF MQ7003	R _θ JA(1)	319 500 438	292 438 292	°C/W
			Junction to Ambient	Junction to Case	
Coupling Factor	MD7003,A,B MD7003,AF MQ7003 (Q1-Q2)	or Q1-Q4)	83 75 57 55	40 0 0	%

⁽¹⁾ $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise note

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	-	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	V(BR)CBO	50	-	= 1	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)	V(BR)EBO	5.0	-	-	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	Ісво	_	-	100	nAdc
ON CHARACTERISTICS					
DC Current Gain(2) (I _C = 100 µAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	h _{FE}	40 50	350 350	_	-

MD7003,A,B,AF, MQ7003

ELECTRICAL CHARACTERISTICS (continued) (T,	A = 25°C	unless otherw	ise noted.)			dor-Emitter Voltage	
Characteristic	3bV	0	Symbol	O Min	Тур	Max	Unit
Collector-Emitter Saturation Voltage (IC = 10 mAdc, IR = 1.0 mAdc)	Vdc mAdc	0	V _{CE(sat)}	OBBV _	0.25	0.35	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		All Die Equal Power	V _{BE(sat)}	-	0.6	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	Wm			g9	no	e Dissipati	lotal Devic
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)		000	oge ^f T	200	300	28 CO	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	ONWm.	000	Cobo	T	3.0		TOM pF
Input Capacitance (VBE = 2.0 Vdc, I _C = 0, f = 100 kHz)		2.28	Cibo		2.0	8.0	pF
Noise Figure (I _C = 100 μ Adc, V _{CE} = 10 Vdc, R _S = 3.0 kohms, f = 10 Hz to 15.7 kHz)	watts	\$9.6	NF	89	2.0	a Dissipati	dB lved late
MATCHING CHARACTERISTICS		0.8	7.0			HALEON	MD2
DC Current Gain Ratio(3) (I _C = 100 μAdc, V _{CE} = 10 Vdc)		7003A,AF 7003B	hFE1/hFE2	0.75 0.85	_		MDP MDP MDP MDP MDP MDP MDP MDP MDP MDP

25 15 mV

Base-Emitter Voltage Differential (I_C = 100 μAdc, V_{CE} = 10 Vdc)

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%. (3) The lowest hfe reading is taken as hfe1 for this ratio.

	One Dig	tiaU
MD7003,A,B MD7003,A,E MQ7003		
MD7003,A,8 MD7003,AF MG7003 (01-02)		

MD7003A,AF MD7003B

VBE1-VBE2

OFF CHARACTERISTICS			
Collector-Base Breakdown Voltage $(C - 10 \mu Adc. E = 0)$			
ON CHARACTERISTICS			

Rating			Symbol	V	alue	Unit
Collector-Emitter Voltage			VCEO	unless othe 04 se noted.)		Vdc
Collector-Base Voltage	gyT	ni	Vсво	Symbol	50	Vdc
Emitter-Base Voltage	BE O		VEBO	VendonV	5.0	Vdc
Collector Current — Co			Ic	127707787	200	mAdc
1.6 Vdc	6.0			One Die	All Die Equal Power	
Total Device Dissipation	n		PD			mW
@ T _A = 25°C MD7007,A,B MD7007F,BF			8	575 350	625 400	
MQ7007 Derate above 25°C				400	600	mW/°C
MD7007,A,B MD7007F,BF MQ7007				3.29 2.0 2.28	3.57 2.28 3.42	
Total Device Dissipation	on	ex	PD	and rand	ADACONA	Watts
MD7007,A,B MD7007F,BF				1.8 1.0	2.5 2.0	
MQ7007 Derate above 25°C			21	0.9 V	3.6 AC007GM	mW/°C
MD7007,A,B MD7007F,BF MO7007				10.3 5.71 5.13	11.4 20.5	.61
Operating and Storage Junction Temperature Range			TJ, T _{stg}		to +200	°C

MD7007,A,B,F,BF **MQ7007**

MD7007,A,B CASE 654-07, STYLE 1



MD7007F,BF **CASE 610A-04, STYLE 1**



MQ7007 **CASE 607-04, STYLE 1**



DUAL **AMPLIFIER TRANSISTOR**

PNP SILICON

THERMAL CHARACTERISTICS

Characteristic		Sy	mbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	MD7007,A MD7007F MQ7007	A,B	BJC	97 175 195	70 87.5 48.8	°C/W
Thermal Resistance, Junction to Ambient	MD7007, MD7007F MQ7007	A,B	UA(1)	304 500 438	280 438 292	°C/W
				Junction to Ambient	Junction to Case	
Coupling Factors						%
	MD7007,			84	44	
	MD7007F			75	0	
	MQ7007	(Q1-Q2)		57	0	
		(Q1-Q2 or Q1-Q	(4)	55	0	

⁽¹⁾ R_{ØJA} is measured with the device soldered into a typical printed circuit board.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				III WILL	
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	-	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	50		-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)	V(BR)EBO	5.0	-	-	Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0)	ІСВО	-	-	100	nAdd
ON CHARACTERISTICS(2)					
DC Current Gain ($I_C = 100 \ \mu Adc, \ V_{CE} = 10 \ Vdc$) ($I_C = 1.0 \ m Adc, \ V_{CE} = 10 \ Vdc$) ($I_C = 10 \ m Adc, \ V_{CE} = 10 \ Vdc$) ($I_C = 50 \ m Adc, \ V_{CE} = 10 \ Vdc$)	hFE	30 30 30 15	110 130 75 25	=	_

		Symbol	Min	Тур	Max	Unit
Vide	0.	VCE(sat)	av L	0.38	1.0	Vdc
mAde	90		pl le	aucunitno	1 - Inemu	Collector
	Alt Dia Equal Power	VBE(sat)	-	0.9	1.5	Vdc
Wim			99	- 10	e Dissipatio	otal Devic
	625	ataft	300	600	25°C 907,A,B	MHz
DRW/m	008	C _{obo}	+	4.0		DAM pF
	3.57 2.28	Cibo	+	3.8		GM pF
	245	63/2			100	17. 181
STRAN	MD7007A MD7007B	hFE1/hFE2	0.75 0.85	=	1.0	- ON (I) COM
D*Wm	MD7007A MD7007B	VBE1-VBE2	=	=	20	mVdc
	Wm DNWm.	abAm 80 80 810 HA 90 90 810 HA 90 90 810 HA 90 90 810 HA 90 90 90 90 90 90 90 90 90 90 90 90 90	MD7007A MD7007A MD7007A MD7007B	MD7007A MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B MD7007B	VCE(sat) — 0.9 VBE(sat) — 0.9 fT 300 600 Cobo — 4.0 Cibo — 3.8 MD7007A MD7007B VBE1-VBE2 — — — — — — — —	VBE(sat)

(3) The lowest hee reading is taken as hee1 for this ratio.

THERMAL CHARACTERISTICS

	One Die	
MD7007,A,B MD7007F,BF MQ7007		
	Junction to Ambient	

(1) RAJA is measured with the device soldered into a typical printed circuit boar

			Vdc
Collector-Base Breakdown Voltage (IC = 10 µAdc, Ig = 0)			
Splitector Current (Vgg = 30 Vdc, Ig = 0)			

Collector-Base Voltage	qy1	Ully	VCBO	Symbol	50	Vdc
Emitter-Base Voltage	_	-	VEBO	VCEfsa	5.0	Vdc
Collector Current — Cont	inuous		Ic		50	mAdc
abV 0.1			8	One Die	All Die Equal Power	
Total Device Dissipation			PD			mW
		200	,	550 350 400	600 400 600	
Derate above 25°C MD7021 MD7021F MQ7021				3.14 2.0 2.28	3.42 2.28 3.42	mW/°C
Total Device Dissipation @ T _C = 25°C MD7021	72		PD	1.4 1.7 0.7 0.7	2.0 1.4 2.8	Watts Fgl.dl
Derate above 25°C MD7021 MD7021F MQ7021				8.0 4.0 4.0	11.4 8.0 16	mW/°C
Operating and Storage Ju Temperature Range	unction	Т	J, T _{stg}	-65	to +200	°C

	120 1 Wildersoterleife
	MD7021 CASE 654-07, STYLE 5
	MD7021F CASE 610A-04, STYLE 1
	MQ7021 CASE 607-04, STYLE 1
An	COMPLEMENTARY GENERAL PURPOSE TRANSISTOR
0	NPN/PNP SILICON

THERMAL CHARACTERISTICS

Characteristic		Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	MD7021 MD7021F MQ7021	$R_{\theta}JC$	125 250 250	87.5 125 62.6	°C/W
Thermal Resistance, Junction to Ambient	MD7021 MD7021F MQ7021	R _θ JA(1)	319 500 438	292 438 292	°C/W
			Junction to Ambient	Junction to Case	
Coupling Factor	MD7021 MD7021F MQ7021 (Q1-Q	2) 3 or Q1-Q4)	83 75 57 55	40 0 0	%

⁽¹⁾ $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	_	_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	V(BR)CBO	50	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	-	-	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	СВО	-		100	nAdc
ON CHARACTERISTICS				HIM N	0.1151
DC Current Gain (I _C = 100 µAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	hFE	40 50	65 70	_	-

11D/021,1, WQ/041							
MD7021.F							
ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}C$	unless otherwise	e noted.)	VCEC	age	mitter Volt	3-10taallo
Characteristic	Vdc	08	Symbol	Min	Тур	Max	Unit
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)(2)			V _{CE(sat)}	DBBV +	_	0.35	8 Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	SDAM	All Ole	V _{BE(sat)}	-	Continuous	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS	Wm						
Current-Gain — Bandwidth Product (I _C = 5.0 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)		608	pee ft	200	320	25°C− 021	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	"PNAtion	600	C _{obo}		-	6.0	pF
Input Capacitance (VBE = 2.0 Vdc, I _C = 0, f = 100 kHz)		3.42	Cibo	-	-	02 0.8	DM pF
SWITCHING CHARACTERISTICS		3.42	2.28			021	(IVIO)
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc}, I_{C} = 150 \text{ m}$	Adc, I _{B1} =	15 Adc)	ton	9	28 10	e 0 <u>(s</u> ripat) 25°C	115
Turn-Off Time $(V_{CC} = 30 \text{ Vdc}, I_C = 150 \text{ mAdc}, I_{B1} = I_{B2} = 150 \text{ mAdc})$		1.4	toff	T	72	021F	ns
2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq	2.0%.				2434	20Ve 25°C	
							MD7 ND7 ND7

Characteristic		All Dia Equal Power	

FLECTRICAL CHARACTERISTICS (Tx = 25°C unless otherwise noted.)

xaM		
		ON CHARACTERISTICS

MAXIMUM RATINGS				
Rating	Symbol	Va	Unit	
Collector-Emitter Voltage MD8001 MD8002 MD8003	OLO		Vdc	
Collector Current — Continuous	Ic		30	mAdc
TO-116		One Die	Both Die Equal Power	aV.
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	, 575 3.29	625 3.57	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 10.3	2.5 14.3	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 t	o +200	°C

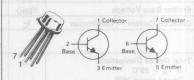
THERMAL CHARACTERISTICS

	Character	ristic	Symbol	One Die Max	Both Die Equal Power Max	Unit
	lesistance, n to Case	to MD918	R _θ JC	97	70	°C/W
	lesistance, n to Ambien	nt	R _θ JA(1)	304	280	°C/W
Unit	Mex	Typ	Nin	Junction to Ambient	Junction to Case	
Coupling	Factor		ar a	84	44	%

(1) R_{BJA} is measured with the device soldered into a typical printed circuit board.

MD8001 MD8002 MD8003

CASE 654-07, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N2920 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Characterist	CERIEBO V		Symbol	Min	Тур		Unit
OFF CHARACTERISTICS		-					Tryde' ič =	M = 311
Collector-Emitter Breakdown (I _C = 10 mAdc, I _B = 0)	Voltage(2)	080 ¹	MD8001 MD8002 MD8003	V(BR)CEO	40 50 60		JUSH CURE 15 Vdc. IE ACTERISTIC 1 Som	Vdc
Collector Cutoff Current (VCB = 40 Vdc, IE = 0)	20			СВО	- (b		5V 50 m I	nAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, IC = 0)		VCE(sat)		IEBO	The second secon	No. of the last of	50	
ON CHARACTERISTICS						DAM U.T =	at ,abam	11 = 011
DC Current Gain (IC = 1.0 mAdc, VCE = 10	Vdc)	(Isa)38¥		hFE	100	200	in Saturati mAde, lg	11 = 31)
SMALL-SIGNAL CHARACTER	ISTICS	-			801	TEIRGIDAR	ANIO JAMES	8-JUAING
Current-Gain — Bandwidth Pi (IC = 5.0 mAdc, VCE = 10		MHz)		fT (ski)	100 N 1 = 100 N	260	on made, Vg	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f =	100 kHz)	odo ²		C _{obo}	0 kHz)	2.6	10 Vdc. 18	pF
Input Capacitance (VBE = 2.0 Vdc, I _C = 0, f =	= 100 kHz)	odio		C _{ibo}	10 kHz)	2.3	o,5 Vdc, Ic	pF
MATCHING CHARACTERISTI	cs	101		UNION I - BONNEY	nis - en e	KV na		Noise Figi
Base-Emitter Voltage Differen (IC = 1.0 mAdc, VCE = 10				V _{BE1} -V _{BE2}	1	-	V alt Pulse V	1

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MD8001 MD8002

MAXIMUM RATINGS

Rating	Symbol	Va	lue 10 mod	Unit
Collector-Emitter Voltage	V _{CEO} 15		Vdc	
Collector-Base Voltage	VCBO	3	0	Vdc
Emitter-Base Voltage	VEBO	3°Wal3	3.67 0.	Vdc
Collector Current — Continuous Total Device Dissipation	Ic	5	0	mAdc
		Each Transistor	Total Device	8.7 E.01
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.65 3.72	1.9 10.88	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.3 7.43	4.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	+ 200	°C IA

MHQ918

CASE 632-02, STYLE 1 TO-116



QUAD

AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MD918 for graphs.

Chara	acteristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			Case	ineldmA				
Collector-Emitter Breakdown Voltage(1) (IC = 3.0 mAdc, IB = 0) Collector-Base Breakdown Voltage (IC = 1.0 \(mu\)Adc, IE = 0)		AA sinnied circuit boa	V(BR)CEO	15 snablog api	ith the devi	actor_ nessured v	Vdc	
			(.baten netweel.)	V(BR)CBO	OE HCS (TA =	ACTERIST	EARD JAD	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	1001	Symbol		V(BR)EBO	3.0	D -	TPRESTAR	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)	26	ово(на)У	Mounes	СВО	(age(2)	loV nwebol	10	nAdc
ON CHARACTERISTICS(1)	60		MDB002					
DC Current Gain $(I_C = 0.1 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 3.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$				hFE			SutoH-Cumi 40 V ol. , Ig	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		003		VCE(sat)	_	0.1(1) =	0.4 0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	101	aari		V _{BE(sat)}	-	0.84	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					ani	PROTOAD	AND ISMO	2-110000
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f =	100 MHz) 🕂		f _T	600	850	ain — Band	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 140 kH	z)	Cobo		C _{obo}	(vbis 0	0.75	2.0	pF pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 140 kH	(z)	Gibo		C _{ibo}	(+H4 0r	1.4	2.5	pF qs2 pF qqr
Noise Figure (I _C = 1.0 mAdc, V _{CE} = 6.0 Vdc, Rs	s = 400 O	hms, f = 60	MHz)	NF	-	4.0	6.0	dB

Rating	Symbol	Symbol Value		
Collector-Emitter Voltage	VCEO	31	V S,81 F	Vdc
Collector-Base Voltage	VCBO	6	0	Vdc
Emitter-Base Voltage	VEBO	5.	0	Vdc
Collector Current — Continuous	1c	50	10	mAdc
39038	C arestr	Each Transistor	Total Device	
Total Device Dissipation (a T _A = 25°C Derate above 25°C	PD	0.65	1.9	Watts
MHQ2222 MPQ2221, MPQ2222		3.72 5.2	10.88 15.2	mW/°C
Operating and Storage Junction Temperature Range MHQ2222 MPQ2221,22	T _J , T _{stg}	- 65 to		°C

MHQ2222 CASE 632-02, STYLE 1 14 TO-116





QUAD **GENERAL PURPOSE TRANSISTOR**

NPN SILICON

Refer to MD2218 for graphs.

Characterist	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(1) (IC	= 10 mAdc, IB = 0)	V(BR)CEO	40	_	_	Vdc
Collector-Base Breakdown Voltage (IC = 10	0 μAdc, I _E = 0)	V(BR)CBO	60	_	_	Vdc
Emitter-Base Breakdown Voltage (IE = 10	μ Adc, IC = 0)	V(BR)EBO	5.0	_	_	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E	= 0)	Ісво	_	_	50	nAdd
Emitter Cutoff Current (VBE = 3.0 Vdc, IC	= 0)	IEBO	_	_	50	nAdd
ON CHARACTERISTICS						
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	MPQ2221 MHQ2222, MPQ2222	hFE	35 75	=	=	-
$(I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPQ2221 MHQ2222, MPQ2222		40 100	=	Ξ	
$(I_C = 300 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPQ2221 MHQ2222, MPQ2222		20 30	=	=	
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)		VCE(sat)	Ξ	=	0.4 1.6	Vdc
Base-Emitter Saturation Voltage ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$) ($I_C = 300 \text{ mAdc}$, $I_B = 30 \text{ mAdc}$)		V _{BE} (sat)	=	=	1.3 2.6	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(1) (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 M	Hz)	fT	200	350	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1 MHz)		C _{obo}	-	4.5	8.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1 MHz)		Cibo	-	17	30	pF
SWITCHING CHARACTERISTICS						
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = 0.5 \text{ Vdc}, I_{C} = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc})$		ton		25	_	ns
Turn-Off Time $(V_{CC} = 30 \text{ Vdc}, I_{C} = 150 \text{ mAdc},$ $I_{B1} = I_{B2} = 15 \text{ mAdc})$		toff	-	250	-	ns

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%. *MPQ2221A and MPQ2222A also available.

DUTY CYCLE = 2 0%

100 μs

100 μs

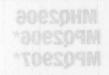
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Refer to MD2218 for graphs.

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			gyT		
		OSB(RB)V			
	MPQ2221 MHQ2222, MPQ2222				
ase-Emitter Seturation Voltage (ic = 150 mAde, lg = 15 mAde) (ic = 300 mAde, lg = 30 mAde)			-	1.3	
urrent-Gain — Sandwidth Product(1) (Ic = 20 mAdc, Vos = 20 Vdc, f = 100 M					
utput Capacitance (VCB = 10 Vdc, $IE = 0$, $f = 1$ MHz)					
igut Capacitance (Vgg = 0.5 Vdc, Ig = 0, f + 1 MHz)					
um-On Time (VCC = 30 Vdc, VBE(om) = 0.5 Vdc, 1C = 150 mAdc, 181 = 15 mAdc)					
wm-Off lime (VCC = 30 Vdc, IC = 150 mAdc, lg1 = 192 = 15 mAdc)					



MAXIMOM NATINGS				
Rating	Symbol	o Val	Value	
Collector-Emitter Voltage	VCEO	abV 15	abV 15	
Collector-Base Voltage	VCBO	abV 40)	Vdc
Emitter-Base Voltage	VEBO	sbArr4.	Vdc	
Collector Current — Continuous	lc	50	Total 0	mAdc
1PO2907 16-06, STYLE 1	CASE 6	Each Transistor	Total Device	\$8151.0F
Total Device Dissipation @ TA = 25°C Derate above 25°C MHQ2369 MPQ2369	PD	0.5 2.86 5.0	1.5 8.58 15	Watts mW/°C
Operating and Storage Junction Temperature Range MHQ2369 MPQ2369	T _J , T _{stg}	-65 to +200 -55 to +125		°C - 65 to -

MHQ2369 MPQ2369

MHQ2369 **CASE 632-02, STYLE 1**



MPQ2369 CASE 646-06, STYLE 1 TO-116



SWITCHING TRANSISTOR **NPN SILICON**

Refer to MD2369 for graphs.

TE 15 TO

ELECTRICAL CHARACTERISTICS (TA = 25°C u	nless otherwise noted.)
Characteristic	wise noted.)
OFF OUADA OTEDIOTION	

Characteristic (beton selwis	Symbol	Min	Тур	ARAMax A	Unit
OFF CHARACTERISTICS OF HIM Indirect	5	italvetoern	Ch		
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	15	- 1	ACTE R ISTICS	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	ol) 40)ec	low n Voltag	nitte r B reeko	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	4.5	vn Vo ltage	ise P re akdey	8 Vdc
Collector Cutoff Current (VCB = 20 Vdc, IE = 0)	ICBO A	01 - 90	ı V alt age	0.48	μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	IEBO =	91.,0 10 9/ 01	(Vc a = 3	0.5	μAdc
ON CHARACTERISTICS	(0)	gi ,abV i	(Vcg = 3.0	tnerru3 tto	nitter Cut
DC Current Gain(1) ($I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mAdc}$, $V_{CE} = 2.0 \text{ Vdc}$)	hFE	40 20	=	GaleTL	N CHARA
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)	_	(abV -0 1 =	0.25	Of Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}	_	_	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS			= 10 Vde)	any abAm	nc = 180
Current-Gain — Bandwidth Product (IC = 10 mAdc, VCE = 10 Vdc, f = 100 MHz)	T MPO29	450	550	_	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1 MHz)	C _{obo}	-	2.5	4.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1 MHz)	C _{ibo}	_(1)6	3.0	5.0	pF
SWITCHING CHARACTERISTICS			/EinestlaV	e Saturation	sea-Emitta
Turn-On Time (V _{CC} = 3.0 Vdc, V _{BE} = 1.5 Vdc, I _C = 10 mAdc, I _{B1} = 3.0 mAdc)	ton	-	9.0	mAde, lg = mAde, lg =	ns
				_	+

toff

 $(V_{CC} = 3.0 \text{ Vdc}, I_{C} = 10 \text{ mAdc}, I_{B1} = 3.0 \text{ mAdc}, I_{B2} = 1.5 \text{ mAdc})$ (1) Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle = 2.0%.

Turn-Off Time

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	fint 40		Vdc
Collector-Base Voltage	VCBO	pay 60		Vdc
Emitter-Base Voltage	VEBO	5.0 5.0		N Vdc
Collector Current — Continuous	lo lo	600 600	mAdc	
TO-116		Each Transistor	Total Device	808 do
Total Device Dissipation @ TA = 25°C Derate above 25°C MHQ2906 MPQ2906, MPQ2907	PD	0.65 3.72 6.5	1.9	watts mw/°C
Operating and Storage Junction Temperature Range MHQ2906 MPQ2906,07	T _J , T _{stg}	- 65 to	+200	2° - 55 to

MPQ2906* MPQ2907*

MHQ2906 CASE 632-02, STYLE 1



MPQ2906 MPQ2907
CASE 646-06, STYLE 1
TO-116



GENERAL PURPOSE
TRANSISTOR

PNP SILICON

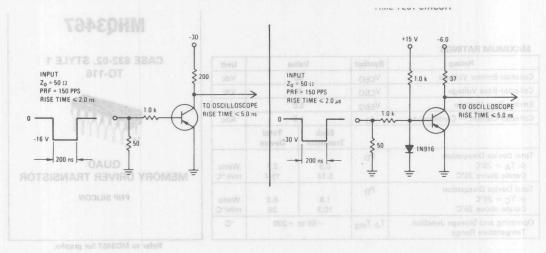
entro zaelnu 3 es ___ Refer to MD2904 for graphs.

FI ECTRICAL	CHARACTERISTIC	S (TA =	25°C unless	otherwise	noted.)

Characteristi	Symbol	Min	Тур	Max	Unit		
OFF CHARACTERISTICS	V(BR)CED	(0 =)	= 10 mAde, lg	ol) (f)age	down Volts	nitter Break	ollector-Er
Collector-Emitter Breakdown Voltage(1) (IC	= 10 mAdc, l _B =	= 0)	V(BR)CEO	40	wn <u>Ye</u> ltagi	ise <u>Bre</u> akdi	Vdc
Collector-Base Breakdown Voltage (IC = 10	μ Adc, $I_E = 0$)		V(BR)CBO	01 60 31	ags <u>tlo</u> V n	e Br <u>es</u> kdov	Vdc
Emitter-Base Breakdown Voltage (IE = 10 J	Adc, IC = 0)		V(BR)EBO	5.0	= 83A) 1	noff <u>C</u> urrer	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E	= 0)083		ICBO 10	- O Vd <u>a</u> IC -	E = <u>ag</u> V)	50	nAdc
Emitter Cutoff Current (V _{CB} = 3.0 Vdc, I _E = 0)				_	_ 8	50	nAdc
ON CHARACTERISTICS - 04	nee -		1.0 Vde)			(f) (f)	Current
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 10 Vdc)		06, MPQ2906	hFE = gl ,sbAm 0	35 96		nitte <u>r S</u> atur	3-rotoello
	MPQ290	7 (abAm	Adc, lg = 1.0			r Sa tu ratio	-
(I _C = 150 mAdc, V _{CE} = 10 Vdc) SHM (I _C = 300 mAdc, V _{CE} = 10 Vdc)	MPQ290	06, MPQ2906	(2)	40	ubon¶ dibi	-	urrent-Ga
1g 0.b 0.5	MPQ290)7		50	0, = 11	91, 3b V 0	(VcB = P
Collector-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)			VCE(sat)	_(sH)	0, 🗀 1 l		Vdc g
Base-Emitter Saturation Voltage(1) (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)	no³	(abAm (VBE(sat)	 10 m	= 1.5 Vdc	1.3 2.6	
SMALL-SIGNAL CHARACTERISTICS	Ho!					en en	nif HO-m
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = 100 M	Hz)	(apwm c.	e = 2.0%.	200 s, Duty Cyc	350 000 > da	Pulse Wid	MHz eal selus
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1 \text{ MHz})$	C _{obo}	-	6.0	8.0	pF		
Input Capacitance ($V_{BE} = 2.0 \text{ Vdc}$, $I_{C} = 0$, $f = 1 \text{ MHz}$)	C _{ibo}	7-	20	30	pF		
SWITCHING CHARACTERISTICS		Hilly His White					
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, I_C = 150 \text{ mAdc}, I_{B1} = 15$	mAdc)		ton	-	30	-	ns
Turn-Off Time (V _{CC} = 6.0 Vdc, I _C = 150 mAdc, I _{B1} = I _B	2 = 15 mAdc)						ns

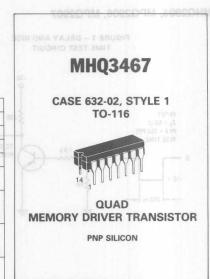
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle = 2.0%.

*MPQ2906A and MPQ2907A also available.



	niM	xeM	

Rating	Symbol	Symbol Value		Unit
Collector-Emitter Voltage	VCEO	40	WI	Vdc
Collector-Base Voltage	VCBO	274 Bat 40 89		Vdc
Emitter-Base Voltage	VEBO	5.0		Vdc
Collector Current — Continuous	ntinuous I _C 1.0) 0	Adc
	5 80	Each Transistor	Total Device	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD,	0.9 5.14	2.7 15.4	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 10.3	6.3 36	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +200		°C



Refer to MD3467 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO	40	-	-	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	40	-	_	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)	V(BR)EBO	5.0	-	1	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	ІСВО	-	-	200	nAdd
Emitter Cutoff Current (V _{BE} = 3.0 Vdc, I _C = 0)	IEBO		-	200	nAdd
ON CHARACTERISTICS					
DC Current Gain(1) (I _C = 500 mAdc, V_{CE} = 1.0 Vdc)	h _{FE}	20	_	-	-
Collector-Emitter Saturation Voltage(1) (I _C = 500 mAdc, I _B = 50 mAdc)	VCE(sat)		0.23	0.5	Vdc
Base-Emitter Saturation Voltage(1) (I _C = 500 mAdc, I _B = 50 mAdc)	VBE(sat)	-	0.9	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS			ME ZE	ALE IN	
Current-Gain — Bandwidth Product(1) $(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz})$	fT	125	190	-	MHz
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1 \text{ MHz})$	C _{obo}		10	25	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0 , f = 1 MHz)	C _{ibo}	_	55	80	pF
SWITCHING CHARACTERISTICS					
Turn-On Time (I _C = 500 mAdc, I _{B1} = 50 mAdc)	ton	<u> </u>	-	40	ns
Turn-Off Time (I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAdc)	toff	-	-	90	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MHQ3798

MAXIMUM RATINGS

Rating CO-SE8 BRA	Symbol	Valu	ue	Unit
Collector-Emitter Voltage	VCEO	12	Vdc	
Collector-Base Voltage	VCBO `	36V 15	,	Vdc
Emitter-Base Voltage	VEBO	4.5	5	Vdc
Collector Current — Continuous	lc	20	0	mAdc
HIMM!		Each Transistor	Total Device	Totals
Total Device Dissipation @ T _A = 25°C Derate above 25°C MHQ3546 MPQ3546	PD	0.5 2.86 4.0	1.5 8.58 12	Watts mW/°C
Operating and Storage Junction MHQ3546	TJ, T _{stg}	- 65 to		°C
Temperature Range MPQ3546		-55 to	+ 150	- 65 to



MHQ3546 CASE 632-02, STYLE 1



MPQ3546 CASE 646-06, STYLE 1



QUAD SWITCHING TRANSISTOR PNP SILICON

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS GYT niM lodmy8			vischetaev	Chi		
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B =	= 0)	V(BR)CEO	12	80	ACTERISTS	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	15	kdo <u>wn</u> Vol	erë retim:	Vdc	
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)		V(BR)EBO	4.5	10	ge automici	Vdc
Collector Cutoff Current (V _{CB} = 10 Vdc, I _E = 0)		СВО	1 - 00 0	Introvenia	0.1	μAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	IEBO	01 - 317	THE PERSON NAMED IN COLUMN	0.1	μAdc	
ON CHARACTERISTICS		10	31 100 00	and the	2 12	7
DC Current Gain(1) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)		hFE	30 15	_ s	ACTERISTAL 1: Gai le (1)	RAHO IRE
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		VCE(sat)	- (= <u>5.0</u> Vdc g = 5.0 Vd	0.25	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)		V _{BE(sat)}	- (bV 0.2 =	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS			agi	abAu 01 =	gl ,abAu 0	05 = 51
Current-Gain — Bandwidth Product(1) (I _C = 10 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)		fT	600		gl., nA <u>dc.</u> Ig	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MHz)		C _{obo}	- (s	05A 2.0		pF
Input Capacitance (V _{BE} = 0.5 Vdc, I _C = 0, f = 1.0 MHz)		C _{ibo}	- 80	3.5	8.0	pF
SWITCHING CHARACTERISTICS						
Turn-On Time (V _{CC} = 2.0 Vdc, V _{BE} (off) = 3.0 Vdc, I _C = 30 mAdc, I _{R1} = 1.5 mAdc)		ton	(sHM (15 f = 1,0 =	The same of the sa	= 85VI
Turn-Off Time (VCC = 2.0 Vdc, IC = 30 mAdc, IB1 = IB2 = 1.5 mAdc)		toff) MH42	25	31.3 <u>hV</u> 8.0	ns

CASE 632-02, STYLE 1 SOUTAR MUMIXAM

MAXIMUM RATINGS	T			
Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	40		Vdc
Collector-Base Voltage	VCBO	60)	Vdc
Emitter-Base Voltage	VEBO	5.0)	Vdc
Collector Current — Continuous	Ic	50)	mAdc
9-00, 31712 1	MG IGAU	Each Transistor	Total Device	dol
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.5 2.86	1.5 8.58	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 5.71	3.5 20	Watts mW/°0
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 65 to	+200	°C

MINU2/30

CASE 632-02, STYLE 1



QUAD AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N3810 for graphs.

ELECTRICAL CHARACTERISTICS (T _A = 25°C unless of		1		Marte
Characteristic	Symbol Min	Тур	Max	Unit
OFF CHARACTERISTICS	(t) (lg = 10 mAdu, tg = 0)	lown Voltage	mitter Breako	Hector-E
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB = 0)	V(BR)CEO 40	wn Voltage	asa Breakdov	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc$, $I_E = 0$	V(BR)CBO 60	17 - co/0	Intell Princes	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V _{(BR)EBO} 5.0	/ 0.0 - po//)	townsun Nov	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)	ICBO —	3811	10	nAdd
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)	I _{EBO} —		20	nAdd
ON CHARACTERISTICS		= 1.0 Vdc)	mAde, Vee	01 = 10
DC Current Gain(1)	hFF	1.0 Vdc)	mAde, Ves	01 =_0
(I _C = 10 μAdc, V _{CE} = 5.0 Vdc) (I _C = 100 μAdc, V _{CE} = 5.0 Vdc)	100 150		mitte r S atura mAd ur Ig =	
$(I_C = 500 \mu\text{Adc}, V_{CE} = 5.0 \text{Vdc})$ $(I_C = 10 \text{mAdc}, V_{CE} = 5.0 \text{Vdc})$	150 125	Voltage 1.0 m Ade)	er Seturation	e-Emits
Collector-Emitter Saturation Voltage ($I_C = 100 \mu Adc$, $I_B = 10 \mu Adc$)	VCE(sat)		0.2	Vdc
$(I_C = 1.0 \text{ mAdc}, I_B = 100 \mu\text{Adc})$	100 MHz)	110 P FC QUEST = 10 Vdc; f =	0.25	T-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1
Base-Emitter Saturation Voltage (I _C = 100 μAdc, I _B = 10 μAdc) (I _C = 1.0 mAdc, I _B = 100 μAdc)	VBE(sat)	M 0.1 - 1.0	0.7	
SMALL-SIGNAL CHARACTERISTICS			monstic	ut Capa
Current-Gain — Bandwidth Product (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	f _T — (S)	130	lo va <u>o</u> ig = G characte	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo} –	2.3 W 0.8 = (90	ma — sm	Tin(pF)
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	C _{ibo} —	5.5	medi_ig1 =	pF
Noise Figure $(I_C = 100 \mu\text{Adc}, V_{CF} = 10 \text{Vdc}, R_S = 3.0 \text{kohms},$	NF —	2.5	= 01.5 mAde	dB
f = 10 Hz to 15.7 kHz)	buty Cycle at 2,0%	au 00€ ≥ n	t: Pulse Widt	sel salu

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMUM RATINGS Rating Symbol Value Unit Collector-Emitter Voltage 45 Vdc VCEO Collector-Emitter Voltage 70 Vdc VCES Collector-Base Voltage **VCBO** 70 Vdc Emitter-Base Voltage 6.0 Vdc **VEBO** Collector Current — Continuous IC 1.5 Adc Four **Transistors** Each Transistor **Equal Power** Total Device Dissipation PD @ $T_A = 25^{\circ}C$ 750 2500 mW Derate above 25°C 4.3 14.3 mW/°C Total Device Dissipation PD $@ T_C = 25^{\circ}C$ 1.2 4.0 Watts Derate above 25°C 6.86 22.8 mW/°C Operating and Storage Junction -55 to +200 °C TJ, Tstg Temperature Range

MHQ4002A

CASE 632-02, STYLE 1 TO-116



QUAD MEMORY DRIVER TRANSISTOR

NPN SILICON

Refer to MD3725 for graphs.

Charact	Symbol	Min	Тур	Max	Unit			
OFF CHARACTERISTICS	*******	manufa					an(Telesation)	GAUN 33
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	(1)	V(88)CE0	£1000HH	V _{(BR)CEO}	45	own Voltage	nitter Breakd	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu Adc, V_{BE} = 0$)			HOSETA	V(BR)CES	70	esetlaV mes	oitter Bracks	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)			HQ4013	V(BR)CBO	70	- (0	= 38 ∀, abAu	or Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	08	V(BR)CBO	нолож	V(BR)EBO	6.0	n Vo lta ge	ise B re akdov uAdo, Ig = C	
Collector Cutoff Current (VCB = 30 Vdc, IE = 0)		OBB(BB)V	HQ4014	СВО	= 10 gAdc	Voltage (Is	000 Breakdown	nAdc
ON CHARACTERISTICS(1)		iceo			Vdc, lg = 0	(Vcs = 50	noff Current	illector C
DC Current Gain	(IC =	100 mAdc, V _C 500 mAdc, V _C 1.0 Adc, V _{CE}	E = 1.0 Vdc)	hFE Ade, Voe =	50 30 20	100 60 45	250 3 TO	N CH ARA Current
Collector-Emitter Saturation Voltage	(IC =	100 mAdc, I _B 500 mAdc, I _B 1.0 Adc, I _B =	= 50 mAdc)	VCE(sat)	(10 - 100 m	0.14 0.23 0.36	0.26 0.52 0.95	Vdc i3-rotselk
Base-Emitter Saturation Voltage	(IC =	100 mAdc, I _B 500 mAdc, I _B 1.0 Adc, I _B =	= 50 mAdc)	VBE(sat)	8.0 (D 8.	0.75 0.88 1.0	0.86 1.1 1.7	Vdc
SMALL-SIGNAL CHARACTERISTICS			(Ade)	ic, lg = 100 n	(IC = 1.0 Ad			
Current-Gain — Bandwidth Product(1 $(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 10 \text{ Vdc})$		Hz)		f _T	200	275	NAL CH ARA	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1.0 MH	lz)			C _{obo}	100 1/1 Hz)	5.0 01	33\10\bAm	oa pF ii
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1.0 MH	Hz)	0.00		C _{ibo}	-	sHM 55 1.0	= 970 bV 0	= pE ¹ /
SWITCHING CHARACTERISTICS		001			1	0, f = 1 MHz	5 Vdc, Ic =	8 = 38V)
Turn-On Time (V _{CC} = 30 Vdc, I _C = 0.5 Adc, V _{BE}	= 3.8 V	'dc, I _{B1} = 50 r	mAdc)	ton		30 319	40 40 6	M ns
Turn-Off Time (V _{CC} = 30 Vdc, I _C = 0.5 Adc, I _{B1} :	= I _{B2} =	50 mAdc)	(ab _i A _i	n 08 t _{off al} a	bV B.E— (No	18 / 60 A 8 I	= 3756V 0	ns
I) Pulse Test: Pulse Width ≤ 300 μs, [Duty Cyc	le ≤ 2.0%		Dibaha	m 02 = cal =	and obn 21	n tida la - d	C = aal

Rating	Symbol	MHQ4013	MHQ4014	Unit
Collector-Emitter Voltage	VCEO	40	45	Vdc
Collector-Emitter Voltage	VCES	60	70	Vdc
Collector-Base Voltage	VCBO	60	70	Vdc
Emitter-Base Voltage	VEBO	oby 6	.0	Vdc
Collector Current — Continuous	Ic	obA 1	.5	Adc
WYYYY		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	750 4.3	2500 14.3	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 6.86	4.0 22.8	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 t	o +200	°C

MHQ4013 MHQ4014

CASE 632-02, STYLE 1



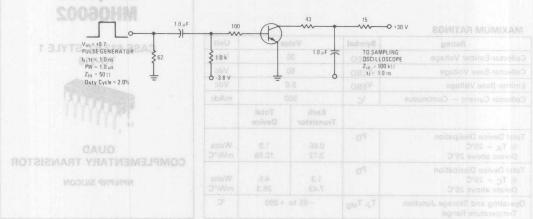
QUAD MEMORY DRIVER TRANSISTOR

NPN SILICON

Refer to MD3725 for graphs.

Chara	cteristic	rounive		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS								
Collector-Emitter Breakdown Voltage((I _C = 10 mAdc, I _B = 0)	1) 88	V(BR)CEO	MHQ4013 MHQ4014	V(BR)CEO	40 45	(0) (dover Voltag	made, 1g = mAde, 1g = nide <u>r Breal</u>	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu Adc, V_{BE} = 0$)	70	080(яв)	MHQ4013 MHQ4014	V _(BR) CES	60 70	= 0) over Voltage 0)	rade, VBE sse Freakde uAdc_lE =	
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	0,8	V(68)680	MHQ4013 MHQ4014	V(BR)CBO	60 70	vn Voltage 0)	e Bresid <mark>ov</mark> — plabAu Hoti C urren	DV Bat 01 = 3
Emitter-Base Breakdown Voltage (IE	= 10 μAdc	$I_{C} = 0$		V(BR)EBO	6.0	_ (0	0 Va <u>اد</u> او =	Vdc
Collector Cutoff Current (V _{CB} = 50	Vdc, IE = 0)			Ісво	_	_ (t)6	500	nAdc
ON CHARACTERISTICS(1)	60	291	(abV 0.1 = g	180 mAde, V _C	= 01)		Gain	Current
DC Current Gain 28	$(I_C = 500 r$	mAdc, V _{CE} = mAdc, V _{CE} = dc, V _{CE} = 5		gl. abAm 000	60 35 25	100 65 50	250	3-retoel
Collector-Emitter Saturation Voltage	$(I_C = 500 r)$	mAdc, IB = 1 mAdc, IB = 5		VCE(sat)	= 30 = 30 = 50	0.14 0.23 0.36	0.26 0.52 0.95	Vdc
Base-Emitter Saturation Voltage	(I _C = 100 r (I _C = 500 r	mAdc, I _B = 1 mAdc, I _B = 5 dc, I _B = 100	10 mAdc) 50 mAdc)	V _{BE(sat)}	0.8	0.75 0.88	0.86 1.1	Vdc
SMALL-SIGNAL CHARACTERISTICS	200	77			(1)	ridth Product	n — Bandy	rent-Gai
Current-Gain — Bandwidth Product(1 (I _C = 50 mAdc, V _{CE} = 10 Vdc, f =		Cobo		t (Z)	200	275	acitance	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1 MHz)		Cibo		C _{obo}	(HZ)	5.0	10 sonsti	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 1 MHz)			C _{ibo}	<u>ISHN</u>	50	70 CHARACT	pF
SWITCHING CHARACTERISTICS		ton					en en	niT nO-n
Turn-On Time (V _{CC} = 30 Vdc, I _C = 0.5 Adc, V _{BE}	off) = 3.8 V	/dc, I _{B1} = 50	mAdc)	ton	7 8.E = 3	20	35	ns
Turn-Off Time (V _{CC} = 30 Vdc, I _C = 0.5 Adc, I _{B1}	= I _{B2} = 50	mAdc)		toff	= <u>182</u> = Duty Cyc	50	60	ns

FIGURE 1 – TURN-ON AND TURN-OFF SWITCHING TIMES TEST CIRCUIT



Refer to WHO2222 for NPN graphs."

(1 _C = 150 mAdc, V _{CE} = 10 V _{de}) MHQ6001 MHQ6001			
	Hol		

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	30	30	
Collector-Base Voltage	VCBO	60)	Vdc
Emitter-Base Voltage	VEBO	5.0)	Vdc
Collector Current — Continuous	lc	50	0	mAdc
		Each Transistor	Total Device	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.65 3.72	1.9 10.88	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.3 7.43	4.6 26.3	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to	+200	°C

MHQ6002

CASE 632-02, STYLE 1 TO-116



QUAD COMPLEMENTARY TRANSISTOR

NPN/PNP SILICON

Refer to MHQ2222 for NPN graphs.*

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(1) (IC = 10 mAdc, IB	(= 0)	V(BR)CEO	30	_	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V _(BR) CBO	60	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		V(BR)EBO	5.0	_	_	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)		СВО	_	-	20	nAdd
Emitter Cutoff Current (VBE = 3.0 Vdc, IC = 0)		IEBO	_	-	30	nAdd
ON CHARACTERISTICS						
C	MHQ6001 MHQ6002	hFE	25 50	Ξ	_	-
	MHQ6001 MHQ6002		35 75	Ξ	_	
C CL	MHQ6001 MHQ6002		40 100	=	_	
CL	MHQ6001 MHQ6002		20 30	_		
Collector-Emitter Saturation Voltage(1) ($I_C = 150 \text{ mAdc}, I_E $ ($I_C = 300 \text{ mAdc}, I_E$		V _{CE} (sat)	=	=	0.4 1.4	Vdc
Base-Emitter Saturation Voltage(1) $(I_C = 150 \text{ mAdc}, I_E I_C = 300 \text{ mAdc}, I_E $		V _{BE(sat)}	_	=	1.3 2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product(1) ($I_C = 50 \text{ mAdc}$, V_{Cl} f = 100 kHz)	E = 20 Vdc,	fT		400	-	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_{E} = 0$, $f = 1 \text{ MHz}$)	NPN PNP	C _{obo}	= 1	6.0 4.5	_	pF
Input Capacitance (VBE = 2.0 Vdc, IC = 0, f = 1 MHz)	NPN PNP	C _{ibo}	==	20 17	=	pF
SWITCHING CHARACTERISTICS			THE P.			
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, V_{BE} = 0.5 \text{ Vdc},$ $I_{C} = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc})$	ton	-	30	-	ns	
Turn-Off Time $(V_{CC} = 30 \text{ Vdc}, I_C = 150 \text{ mAdc}, I_{B1} = I_{B2} = 15 \text{ mAdc})$		toff	=	225	_	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

*Refer to MHQ2907 for PNP graphs.

Conector-pase voltage	VCBO	any 3	0	Vdc
Emitter-Base Voltage	VEBO	abV 3.0		Vdc
Collector Current — Continuous	Ic	-pbAme	60	mAdc
SE 646-06, STYLE 1 TO-116	CAS	Each Transistor	Four Transistors Equal Power	doi sistor
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	6.7 0.825	2.4 19.2	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to	+ 150	ol °C

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 134	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	% %

MPQ918

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MD918 for graphs.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			P	ACTERIBITO	EF CHAR
Collector-Emitter Breakdown Voltage(1) (I _C = 3.0 mAdc, I _B = 0)	V(BR)CEO	15	etloV nwob	Isaali jettio	Vdc
Collector-Base Breakdown Voltage (I _C = 1.0 μAdc, I _E = 0)	V(BR)CBO	30	- (0	≓ gl ⇔ bAm	07 Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	V(BR)EBO	3.0	wn Ve ltaga	use P re akdo	Vdc
Collector Cutoff Current (V _{CB} = 15 Vdc, I _E = 0)	ІСВО	-	(0	10	nAdc
ON CHARACTERISTICS(1)			spsilev n	wobskate a	esa-rettir
DC Current Gain ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 3.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 10 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	hFE	20	110 80 50	itoff Current 10 Vd <u>o,</u> fg ±	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{CE(sat)}	_	0.11	0.4	Vdc
Base-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	V _{BE(sat)}	_	0.84	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				nio 3	toown 3
Current-Gain — Bandwidth Product (I _C = 4.0 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	600	(abV 01 =	mAde, Ves	
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1 MHz)	Cobo	_	0.75	1.7	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1 MHz)	Cibo	9	silo\1.1olis	2.0	pF
Noise Figure (I _C = 1.0 mAdc, V _{CE} = 6.0 Vdc, R _G = 400 Ohms, f = 60 MHz)	NF		4.0	6.0	dB

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	Mn Va	Value	
Collector-Emitter Voltage	VCEO	oby 2	oby 20	
Collector-Base Voltage	VCBO	JbV 4	sbv 40	
Emitter-Base Voltage	VEBO	abV4	ob / 4.0	
Collector Current — Continuous	lc	500		mAdc
IE 646-06, STYLE 1 TO-116	CAS	Each Transistor	Four Transistors Equal Power	ich sistor
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	650 5.18	1250 10	mW mW/°C
Derate above 25 C				
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	3.0 24	Watts mW/°C

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	(1) Each Die Effective, 4 Die	125 41.6	193 100	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	30 2.0	60 24	%

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

MPQ1000

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MD2218 for graphs.

MinU xall qyT Cha	racterist	tic lodmy8		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						8:	ACTERISTIC	PF CHARL
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	e(2)	V(BRICEO V(BRICEO	(0 = 8	V(BR)CEO	20	dow <u>n</u> .Velta wn Veltage		Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	3.0	083(88)V		V(BR)CBO	0140	age ste V na	e Br os kdov	Vdc
Emitter-Base Breakdown Voltage (IF = 10 µAdc, IC = 0)				V(BR)EBO	4.0	00.	оптепявато,	Vdc
Collector Cutoff Current (VCB = 30 Vdc, IE = 0)	20	3911		ІСВО	VCE = 1.	= 9.1 mAdd = 3.0 mAdd = 10 mAdd	50	nAdc
Emitter Cutoff Current (VEB = 2.0 Vdc, IC = 0)		VCE(sat)	1.0 mAde)	EBO m o	= 20 si	ation Voltag	50	nAdc
ON CHARACTERISTICS(2)	-	VBE(890)	labAm	0.4 = g1 ,30A)	m or = or	apanov u	r saturatio	ilimid-esi
DC Current Gain	000	fr Enha	- 10 Vdc.	D mAde, VGE		ACTERISTA iditi Produc —	n — Bandy	urrent-Ga f = 100 f
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)		Cibo		VCE(sat)	,0 = 0,	BE = 0.6 VB	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)		1 10 10	Star of -1 smile	VBE(sat)	E - 6.0 Vis 8, Duty Cyt	tin ≤ 300 µ	1.3	Vdc
SMALL-SIGNAL CHARACTERISTICS								
Current-Gain — Bandwidth Product (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)			fT	175	-	-	MHz	
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1 MHz)			C _{obo}	-	-	8.0	pF	
Input Capacitance (VBF = 0.5 Vdc, IC = 0, f = 1 MH	(z)			Cibo	-	-	30	pF

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

IVIAXIIVIUIVI RATIIVGS	FigU 6			
Rating	Symbol	Jan Va	alue	Unit
Collector-Emitter Voltage	VCEO	Vdc	20	Vdc
Collector-Base Voltage	VCBO	oby 4	40	Vdc
Emitter-Base Voltage	VEBO	ubAm4	1.0	Vdc
Collector Current — Continuous	us I _C 500		00	mAdc
YYYY		Each Transistor	Four Transistors Equal Power	ach nelster
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	0.65 5.18	1.25 8.0	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0	3.0 24	Watts mW/°C
Operating and Storage Junction T _J , Temperature Range		- 55 t	o +150	°C

MPQ1500

CASE 646-06, STYLE 1 TO-116



QUAD TRANSISTOR

PNP SILICON

THERMAL CHARACTERISTICS

Characteristic	Junction to Case	Junction to Ambient	Unit
Thermal Resistance(1)	The state of the s	256	°C/W
Each Die	125	193	
Effective, 4 Die	41.6	100	
Coupling Factor		18 1 30	%
Q1-Q4 or Q2-Q3	30	60	
Q1-Q2 or Q3-Q4	2.0	24	

Refer to MPQ2907 for graphs.

(1) Junction to ambient data applies for typical printed circuit board mounting.

Characteris	tic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	ransamV			0	ostaV nece	Wisselff name	a intention
Collector-Emitter Breakdown Voltage(1) (I _C = 10 mAdc, I _B = 0)	esanina V		V(BR)CEO	20	— (0 spatioV ou	gr _i _e bl _o s	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	ceol		V _(BR) CBO	40	- (0	a gl Aka Smott Cume	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	nesi		V _{(BR)EBO}	4.0	<u>-</u> (0 =	45 Vilo. 1g -	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)			ICBO	_	-40 =	50 00	nAdc
Emitter Cutoff Current (VEB = 2.0 Vdc, I _C = 0)	398	MPC2483	IEBO		- 50 W	50	nAdo
ON CHARACTERISTICS(1)		WPO2484					TO A
DC Current Gain (IC = 10 mAdc, VCE = 10 Vdc) (IC = 50 mAdc, VCE = 10 Vdc) (IC = 150 mAdc, VCE = 10 Vdc)		MPQ2483 MPQ2484	hFE	50 50 40	100 120 80	gV .obAm 0	(= <u>0</u> ()
Collector-Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc)			V _{CE(sat)}	-	0.22	0.5	Vdc
Base-Emitter Saturation Voltage (IC = 150 mAdc, IB = 15 mAdc)	(response		V _{BE(sat)}	- 6	0.89	1.3mg	Vdc
SMALL-SIGNAL CHARACTERISTICS				(8	legstloV no	ter Saturatio	Amil-ses
Current-Gain — Bandwidth Product(1) (I _C = 20 mAdc, V _{CE} = 20 Vdc, f = 100 M	ЛHz)		fT	150	300	00 p <u>Ad</u> to, Vig 9 mAdo, Vig	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 1 MHz)	7		C _{obo}	_801	4.0	8.0	pF
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1 MHz)			C _{ibo}	c. f = 20 f	17	30	pF

Rating	Symbol	Value		Unit
Collector-Emitter Voltage VCEO		anu a	10	Vdc
Collector-Base Voltage	VCBO	aby (60	Vdc
Emitter-Base Voltage	VEBO	36V 6	5.0	Vdc
Collector Current — Continuous	lc	Vac .	50	mAdc
		Each Transistor	Four Transistors Equal Power	iù rios
Total Device Dissipation @ T _A = 25°C(1) Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.825 6.7	2.4 19.2	Watts mW/°C
Operating and Storage Junction TJ, Tstg		-55 t	o + 150	°C

 Second Breakdown occurs at power levels greater than 3 times the power dissipation rating.

THERMAL CHARACTERISTICS

	cteristic	Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 134	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	% %

MPQ2484

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER TRANSISTOR

NPN SILICON

Refer to 2N2919 for graphs.

ELECTRICAL CHARACTERISTICS	$S(T_A =$	25°C unless of	otherwise noted.)	2.0			01-02 c - 03-04	
Cha	racteris	tic	t beard mounting.	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS								
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	e(2)		Colorest Somethin	V(BR)CEO	40		THE REAL PROPERTY.	Vdc
Collector-Base Breakdown Voltage $(I_C = 10 \mu Adc, I_E = 0)$		Viesiceo		V(BR)CBO	60	LCS slotewar Vol	ACTERIST mitter Bre	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ Adc, IC = 0)				V _{(BR)EBO}	6.0	(0 = town Valter	gl _{cab} Am dese Breste	Vdc
Collector Cutoff Current (VCB = 45 Vdc, I _E = 0)	0.5	Vermen		ICBO		= .0) www.Voltage	20	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)		ORDI		IEBO	_	10 =	20	nAdc
ON CHARACTERISTICS						(0 =	at any us	= 80V)
DC Current Gain(2) (I _C = 0.1 mAdc, V _{CE} = 5.0 Vdc)		083	MPQ2483 MPQ2484	hFE	100		soff Currer 2.0 V <u>d</u> e, lig act -t ts ti	= 63VI
$(I_C = 1.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$ $(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$			MPQ2483 MPQ2484 MPQ2483		150 300	16 V 07 = 9 2 = 70 Vd 3 = 10 Vd	t Gain mAde, Ve I mAde, Ve is mAde, V	C Currer (lo = 1 (lo = 5) (lo = 1
30V 6.0 27.0		VOELSet)	MPQ2484	1174	300	IOV soliens	Ind sating	ro/sello
Collector-Emitter Saturation Voltage (I _C = 1.0 mAdc, I _B = 0.1 mAdc) (I _C = 10 mAdc, I _B = 1.0 mAdc)				VCE(sat)	_ (o	0.13		Vdc
Base-Emitter Saturation Voltage(2) (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc) (I _C = 10 mAdc, V _{CE} = 5.0 Vdc)	oar	Ŧ		V _{BE} (sat)	108 uet(17 1 - 100 t	0.58 0.70	0.7 0.8	Vdc
SMALL-SIGNAL CHARACTERISTICS	5	Cohn					eanst obla	s 5 Juntary
Current-Gain — Bandwidth Product (I _C = 500 μ Adc, V _{CE} = 5.0 Vdc, f	= 20 N	MHz)		fT	50	100	10 video lg	MHz
Input Capacitance (VBE = 0.5 Vdc, IC = 0, f = 1 MH	łz)			Cibo	<u>IshiM</u> Susu Cusu C	4.0	8.0	pF

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^{\circ}$ C unless otherwise noted.) Characteristic Symbol Min Typ Max Unit Collector-Base Capacitance C_{Cb} — 1.8 6.0 pF

Collector-Base Capacitance (VCB = 5.0 Vdc, IE = 0, f = 1 MHz)

Noise Figure (IC = 10 \(\mu \text{Adc}, \text{ VCE} = 5.0 \text{ Vdc}, RS = 10, kohms, f = 10 Hz to 15.7 kHz, BW = 10 kHz)

MPQ2483 — 3.0 — 2.0 —

(2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

MPQ2906, 2907 For Specifications, See MHQ2906 Data.

MAXIMUM RATINGS

Rating	Symbol	(belonVa	lue erito sonin	Unit
Collector-Emitter Voltage	VCEO	10¢my8	12	Vdc
Collector-Base Voltage	VCBO	4-3	25	Vdc
Emitter-Base Voltage	VEBO	4	1.0	Vdc
Collector Current — Continuous	lc	46	.0	Adc
- 0s		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	650 5.2	1250 10	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0 8.0	3.0 24	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

MPQ3303

CASE 646-06, STYLE 1 TO-116



QUAD SWITCHING TRANSISTOR

NPN SILICON

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	125 41.6	193* 100*	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	30 2.0	60 25	% %

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	12	-	-	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	V _(BR) CBO	25		-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc$, $I_C = 0$)	V(BR)EBO	4.0	-		Vdc
Collector Cutoff Current (V _{CE} = 15 Vdc, V _{BE} = 0)	CES			100	μAdc
ON CHARACTERISTICS					
DC Current Gain (I _C = 100 mAdc, V _{CE} = 0.5 Vdc) (I _C = 300 mAdc, V _{CE} = 0.5 Vdc)	hFE	30 40	45 55	 200	-
Collector-Emitter Saturation Voltage (I _C = 300 mAdc, I _B = 30 mAdc) (I _C = 1.0 Adc, I _B = 0.1 Adc)	V _{CE} (sat)	=	0.22 0.52	0.33 0.7	Vdc
Base-Emitter Saturation Voltage (IC = 300 mAdc, I _B = 30 mAdc) (I _C = 1.0 Adc, I _B = 0.1 Adc)	V _{BE} (sat)	Ξ	0.87 1.04	1.1 1.4	Vdc
SMALL-SIGNAL CHARACTERISTICS				HE STATE	Rate
Current-Gain — Bandwidth Product (IC = 100 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	fT	400	500	-	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1 MHz)	C _{obo}	_	5.0	10	pF
Input Capacitance $(V_{BE} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1 \text{ MHz})$	C _{ibo}	_	22	30	ρF
SWITCHING CHARACTERISTICS					
Turn-On Time $(V_{CC} = 12 \text{ Vdc}, I_C = 1.0 \text{ Adc}, V_{BE(off)} = 4.0 \text{ Vdc}, I_{B1} = 100 \text{ mAdc})$	ton	-	12	15	ns
Turn-Off Time $(V_{CC} = 12 \text{ Vdc}, I_C = 1.0 \text{ Adc}, I_{B1} = I_{B2} = 100 \text{ mAdc})$	toff	-	18	25	ns

Emitter-Base Voltage	VEBO	201U	5.0	Vdc
Collector Current — Continuous	IC IC	309	1.0	Adc
TO-116		Each Transistor	Four Transistors Equal Power	99
Total Device Dissipation @ T _A = 25°C(1) Derate above 25°C	PD	650 5.2	1500 12	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.25	3.2 25.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 t	o +150	°C

(1) Second Breakdown occurs at power levels greater than 2 times the power dissipation rating.

THERMAL CHARACTERISTICS

Charac	teristic of an enterior	R _B JC Junction to Case	R _B JA Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	100 39	193 83.2	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	45 5.0	55 10	%

IUTCYTIN

CASE 646-06, STYLE 1 TO-116



QUAD MEMORY DRIVER TRANSISTOR

PNP SILICON

Refer to MD3467 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) entry seeing 1975 = AT CONTRIBETOARIAMO JACHITOLIS

sight sale gyr Cha	Symbol	Min	Тур	Max	Unit			
OFF CHARACTERISTICS								
Collector-Emitter Breakdown Voltag (I _C = 10 mAdc, I _B = 0)	e(2)			V(BR)CEO	40	kdos ta Vel (0)	mitt er. Bres mAdo, Ig	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)	50	Viagross	MPQBIZGA	V(BR)CBO	40	HaV revelos	mider Brez	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	90 70		MPG3725 MPG372EA	V(BR)EBO	5.0	<u>10</u> = 3	gV Janes Vig	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	0.0	QGS(R8)V		ІСВО	_	egangy ny (0)	200	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)		080)		IEBO		- (0 -	200	nAdo
ON CHARACTERISTICS						(8/8)	Methalo	HARU V
DC Current Gain(2) (I _C = 500 mAdc, V _{CE} = 1.0 Vdc)	35	394	MPGB725	hFE	20	6V 0.T = g	osa D mAde, Ve	(IC = 19
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)	e(2)		- ACTION IN	VCE(sat)	- (0	0.23	0.5 V obAm (Vdc
Base-Emitter Saturation Voltage(2) (I _C = 500 mAdc, I _B = 50 mAdc)	30	VanagaV	MPGISTZSA	V _{BE} (sat)		0.90	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS	S				(:	bAm 08 =	gi ,abAm (10 - 20k
Current-Gain — Bandwidth Product (I _C = 50 mAdc, V _{CE} = 10 Vdc, f		MHz)		fT	125	190	er Satorack) mAdio, (g	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 k	Hz)	1 4		C _{obo}	_ 83	10	25	1
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100	kHz)		MPQ3726 MPQ3725A	C _{ibo}	W 001 = 3	55	80	pF
SWITCHING CHARACTERISTICS					HERMAN		ecitance	iput Can
Turn-On Time (I _C = 500 mAdc, I _{B1} = 50 mAdc		odiO		ton	(Lety 1	DI 97.0	40	ns
Turn-Off Time (I _C = 500 mAdc, I _{B1} = I _{B2} = 50	mAdc)			toff	ESPIN O	0) = 1,0 =	90	ns

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating	Symbol	MPQ3725	MPQ3725A	Unit
Collector-Emitter Voltage	VCEO	40	50	Vdc
Collector-Emitter Voltage	VCES	60	70	Vdc
Emitter-Base Voltage	VEBO	5	.0	Vdc
Collector Current — Continuous	Ic	1	.0	Adc
		One Transistor	Four Transistors Equal Power	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	1.0	2.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	- 55 to + 150		°C

THERMAL CHARACTERISTICS

Characteristics	Symbol	M	ax	Unit
Refer to MEXAGO for graphs.		One Transistor	Effective For Four Transistors	jl o
Thermal Resistance, Junction to Ambient(1)	$R_{\theta JA}$	125	50	°C/W

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

MPU3/25,A

CASE 646-06, STYLE 1 TO-116



QUAD CORE DRIVER TRANSISTOR

NPN SILICON

Refer to MD3725 for graphs.

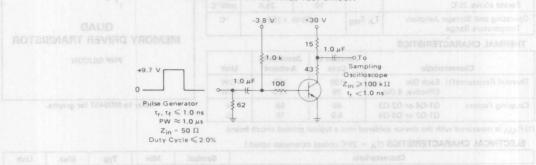
the Characteris	tic loday?		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					. 80	ACTEMEN	AHD TH
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BB)CEO	MPQ3725 MPQ3725A	V _(BR) CEO	40 50	katowin Volta = (0) <u> </u>		Vdc
Collector-Emitter Breakdown Voltage (I _C = 100 μAdc, V _{BE} = 0)	ОВЗ(ЯВ)Ў	MPQ3725 MPQ3725A	V(BR)CES	60 70	o) en V ol age o) –	pAdc. 1g = su B salida pAu s. 1g =	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	060 ¹		V _{(BR)EBO}	5.0	- 10 10	utor) C ture	
Collector Cutoff Current (VCB = 40 Vdc, I _E = 0)	OBS		ІСВО		- 10	0.5	μAdc
ON CHARACTERISTICS(2)					8	orreletto/	SIAHO H
DC Current Gain (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)	344	MPQ3725 MPQ3725A	hFE	40	75 80	200	
(I _C = 500 mAdc, V _{CE} = 2.0 Vdc)		MPQ3725 MPQ3725A		25 30	45 50	mater seed a made, ig ir Samresie	lig = 50
Collector-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)	18801262		VCE(sat)	08	0.32	0.45	Vdc
Base-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc)	11		VBE(sat)		0.9	tone 1.0	
SMALL-SIGNAL CHARACTERISTICS	Cabo					eprehoa	opin rugge
Current-Gain — Bandwidth Product $(I_C = 50 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ N})$	ИНz)	MPQ3725 MPQ3725A	fT	250 200	275 250	o voc. (g	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)			C _{obo}	_	80/5.1	100 8	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)	No.		C _{ibo}	— (a)	62	80	

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
SWITCHING CHARACTERISTICS	abV-	5.6		OBBV		aguileV e	mitter-Ban
Turn-On Time (I _C = 500 mAdc, I _{B1} = 50 mAdc, V _{BE(off)} = 3.8 Vdc	c)	(i.b)	ton	91 -	20	35	O sons los
Turn-Off Time (I _C = 500 mAdc, I _{B1} = I _{B2} = 50 mAdc)		Transferora Equal Power	dae toff	-	50	60	ns

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.





| Option | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Programme | Program

Rating	Symbol	Va	Unit	
Collector-Emitter Voltage	VCEO	unitest other 04se noted.)		Vdc
Collector-Base Voltage	VCBO	iaSmy8 4	40	Vdc
Emitter-Base Voltage	VEBO	5	5.0	Vdc
Collector Current — Continuous	IC	ngf 1	.5	Adc
en 08 03		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	750 5.98	1700 13.6	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.25 g v : 10	3.2 25.6	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characte	eristic	Junction to Case	Junction to Ambient	Unit	
Thermal Resistance(1)	Each Die Effective, 4 Die	100 39	167 73.5	°C/W	
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	46 5.0	56 10	%	

MP03762

CASE 646-06, STYLE 1 TO-116



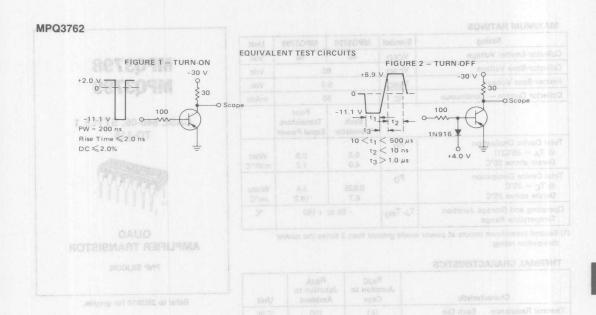
QUAD MEMORY DRIVER TRANSISTOR

PNP SILICON

Refer to MD3467 for graphs.

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	40	-	<u> </u>	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	40		-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)	V _{(BR)EBO}	5.0	-	-	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	СВО		_	100	nAdd
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)	IEBO	-	=	100	nAdd
ON CHARACTERISTICS(2)					
DC Current Gain (IC = 150 mAdc, VCE = 1.0 Vdc) (IC = 500 mAdc, VCE = 2.0 Vdc) (IC = 1.0 Adc, VCE = 2.0 Vdc)	hFE	35 30 20	70 65 35		
Collector-Emitter Saturation Voltage ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$) ($I_C = 1.0 \text{ Adc}$, $I_B = 100 \text{ mAdc}$)	VCE(sat)		0.3 0.6	0.55 0.9	Vdc
Base-Emitter Saturation Voltage (I _C = 500 mAdc, I _B = 50 mAdc) (I _C = 1.0 Adc, I _B = 100 mAdc)	V _{BE} (sat)	=	0.9	1.25 1.4	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (I _C = 50 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	150	275	_	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}		9.0	15	pF
Input Capacitance ($V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz}$)	C _{ibo}		55	80	pF
SWITCHING CHARACTERISTICS				世上的	
Turn-On Time ($V_{CC}=30~Vdc,~I_{C}=1.0~Adc,~I_{B1}=100~mAdc,~V_{BE(off)}=2.0~Vdc)$	ton			50	ns
Turn-Off Time $(V_{CC} = 30 \text{ Vdc}, I_C = 1.0 \text{ Adc}, I_{B1} = I_{B2} = 100 \text{ mAdc})$	toff		-	120	ns



Collector-base voltage	VCBO	5.0		Vdc	
Emitter-Base Voltage	VEBO			Vdc	
Collector Current — Continuous	Ic	1000	50	mAdc	
D w	0	Each Transistor	Four Transistors Equal Power		
Total Device Dissipation @ TA = 25°C(1) Derate above 25°C	PD	0.5 4.0	0.9 7.2	Watt mW/°C	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.825 6.7	2.4 19.2	Watts m/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C	

⁽¹⁾ Second breakdown occurs at power levels greater than 3 times the power dissipation rating.

THERMAL CHARACTERISTICS

Charac	teristic	R _B JC Junction to Case	R _B JA Junction to Ambient	Unit	
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 139	°C/W	
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	%	

MPQ3799

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER TRANSISTOR

PNP SILICON

Refer to 2N3810 for graphs.

ELECTRICAL	CHARACTERISTICS	$(T_A =$	25°C unless	otherwise n	oted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	MPQ3798 MPQ3799	V(BR)CEO	40 60	_	=	Vdc
Collector-Base Breakdown Voltage ($I_C = 10 \mu Adc, I_E = 0$)		V(BR)CBO	60		-	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)		V(BR)EBO	5.0		_	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)		СВО		-	10	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)		IEBO			20	nAdc
ON CHARACTERISTICS(2)						
DC Current Gain (I _C = 10 μ Adc, V _{CE} = 5.0 Vdc)	MPQ3798 MPQ3799	hFE	100 225	Ξ	Ξ	-
$(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	MPQ3798 MPQ3799		150 300	= .	_	1111
$(I_C = 500 \ \mu Adc, V_{CE} = 5.0 \ Vdc)$	MPQ3798 MPQ3799		150 300	=		
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	MPQ3798 MPQ3799		125 250			
Collector-Emitter Saturation Voltage (I _C = 100 μ Adc, I _B = 10 μ Adc) (I _C = 1.0 mAdc, I _B = 100 μ Adc)		VCE(sat)	=	0.12 0.07	0.2 0.25	Vdc
Base-Emitter Saturation Voltage ($I_C = 100 \mu Adc$, $I_B = 10 \mu Adc$) ($I_C = 1.0 \mu Adc$, $I_B = 100 \mu Adc$)		VBE(sat)	=======================================	0.62 0.68	0.7 0.8	Vdc

Characteristic			Symbol	Min	Тур	Max	Unit
SMALL-SIGNAL CHARACTERISTICS	3/5/	0.0		ranaV I		enerioV s	e S-vertime
Current-Gain — Bandwidth Product (I _C = 1.0 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)	gbAm:	200	fT	60	250	urrent — Co	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)		Fauri frances	C _{obo}	-	2.1	4.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)	Man	1000	Cibo	ys =	5.5	8.0	pF
Noise Figure (I _C = 100 μ Adc, V _{CE} = 10 Vdc, R _S = 3.0 kohms, f = 10 Hz to 15.7 kHz)		1PQ3798 1PQ3799	0.5 NF	2 ^q =	2.5 1.5	ove 25°C e Distipatio 25 C	u.
2) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0	1%.	19.2	6.7			Ove 25°C	de overeio

			obV
00 Current Gain 00 = 0.1 mAde, Vot = 1.0 Vdc) 00 = 1.0 mAde, Vot = 1.0 Vdc) 1.0 = 10 mAde, Vot = 1.0 Vdc)	Báq		
u n-0a 11me (1g = 16 mAde, (8) = 1gg = 1,0 mAde)			

Rating	Symbol	Va	Unit	
Collector-Emitter Voltage	VCEO	Loeron su	Vdc	
Collector-Base Voltage	VCBO	одицув	60	Vdc
Emitter-Base Voltage	VEBO	(5.0	Vdc
Collector Current — Continuous	Ic	2	100	mAdc
3q 0.8 f.S		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	825 6.7	2.4 19.2	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55 t	o +150	°C

THERMAL CHARACTERISTICS

Charac	teristic	Junction to Case	Junction to Ambient	Unit	
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 139	°C/W	
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	% %	

MPQ3904

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER/SWITCHING TRANSISTOR

NPN SILICON

Refer to 2N3904 for graphs.

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Vdc Vdc Vdc
Vdc
Vdc
n A da
паас
nAdd
Vdc
Vdc
MHz
pF
pF
Y TE
ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMUM RATINGS				
Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	4	10	Vdc
Collector-Base Voltage	VCBO		10	Vdc
Emitter-Base Voltage	VEBO	5	5.0	Vdc
Collector Current — Continuous	Ic	BEIN CI2	- DELAY 00	mAdc
		Each Transistor	Four Transistors Equal Power	AVIUS
Total Device Dissipation (@ T _A = 25°C Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	825 6.7	2.4	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit	
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 139	°C/W	
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	% %	

MPQ3906

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER/SWITCH TRANSISTOR

PNP SILICON

Refer to 2N3906 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

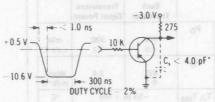
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	1				Farm I
Collector-Emitter Breakdown Voltage(1) (IC = 1.0 mAdc, IB = 0)	V(BR)CEO	40	-	-	Vdc
Collector-Base Breakdown Voltage (IC = 10 μ Adc, IE = 0)	V(BR)CBO	40	-		Vdc
Emitter-Base Breakdown Voltage 2301030000 bits gli 1291 li (IE = 10 μ Adc, IC = 0)	V(BR)EBO	5.0		-	Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)	СВО		_=	50	nAdc
Emitter Cutoff Current (V _{BE} = 4.0 Vdc, I _C = 0)	IEBO	-	-	50	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain	hFE	40 60 75	160 180 200	_	
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)	-	0.1	0.25	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 1.0 \text{ mAdc}$)	V _{BE} (sat)	-	0.65	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	200	250	-	MHz
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_E = 0$, $f = 140 \text{ kHz}$)	C _{obo}	_	3.3	4.5	pF
Input Capacitance ($V_{BE} = 0.5 \text{ Vdc}$, $I_{C} = 0$, $f = 140 \text{ kHz}$)	C _{ibo}	-	4.8	10	pF
SWITCHING CHARACTERISTICS					
Turn-On Time (I _C = 10 mAdc, $V_{BE(off)}$ = 0.5 Vdc, I_{B1} = 1.0 mAdc)	ton	-	43	-	ns
Turn-Off Time (I _C = 10 mAdc, I _{B1} = I _{B2} = 1.0 mAdc)	toff	-	155	-	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

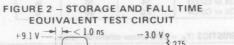
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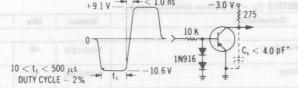
OUAD AMPLIFIER/SWITCH TRANSISTOR

Rafer to 27/2906 for graphs.



5





*Total shunt capacitance of test jig and connectors

Collector-Base Voltage	VCBO	pamys	60	Vdc
Emitter-Base Voltage	VEBO	(es)30V E	5.0	Vdc
Collector Current — Continuous	Ic	5	00	mAdc
7.3 Vdc		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ T _A = 25°C(1) MPQ6001, MPQ6002, MPQ6501, MPQ6502	PD	0.65	1.25	Watts
Derate above 25°C MPQ6001, MPQ6002, MPQ6501, MPQ6502		5.18	10	mW/°C
Total Device Dissipation @ T _C = 25°C MPQ6001, MPQ6002, MPQ6501,	PD	odi [©]	NP PN	Watts
MPQ6502 Derate above 25°C MPQ6001, MPQ6002, MPQ6501, MPQ6502		1.0	3.0	mW/°C
Operating and Storage Junction Temperature Range	- 55 t	°C		

STYLE 1

MPQ6501

MPQ6502

STYLE 2

CASE 646-06



QUAD COMPLEMENTARY PAIR TRANSISTOR

PNP/NPN SILICON

THERMAL CHARACTERISTICS

	Characteristic	Junction to Case	Junction to Ambient	Unit
Thermal Resistance Each Die Effective, 4 Die	MPQ6001, MPQ6002, MPQ6501, MPQ6502 MPQ6001, MPQ6002, MPQ6501, MPQ6502	125	193	°C/W
Coupling Factors		30	60	%
coupling ractors	MPQ6001, MPQ6002	30	60	
Q1-Q4 or Q2-Q3	MPQ6501, MPQ6502	30	60	
	MPQ6001, MPQ6002	30	60	
Q1-Q2 or Q3-Q4	MPQ6501, MPQ6502	20	24	
		20	24	
		20	24	
		2.0	24	

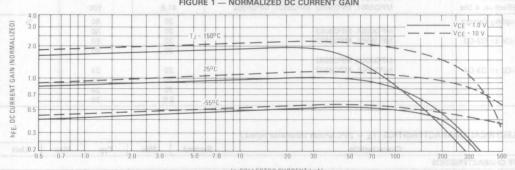
Characteristic	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS	A STATE OF THE STA					
Collector-Emitter Breakdown Voltage(2) (IC =	10 mAdc, I _B = 0)	V(BR)CEO	30	_	-	Vdc
Collector-Base Breakdown Voltage (IC = 10)	μAdc , $I_E = 0$)	V(BR)CBO	60		_	Vdc
Emitter-Base Breakdown Voltage (IE = 10 μ A	Adc, IC = 0)	V(BR)EBO	5.0	- £ 3 <u>8</u> UDR	_	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E =	0)	ІСВО	+		30	nAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC =	IEBO			30	nAdc	
ON CHARACTERISTICS						
DC Current Gain(2) $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPQ6001, MPQ6501 MPQ6002, MPQ6502	hFE	25 50	1914 (Table 1		Tile West
$(I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPQ6001, MPQ6501 MPQ6002, MPQ6502		35 75	Tayle as	= =	80 5
(I _C = 150 mAdc, V _{CE} = 10 Vdc)	MPQ6001, MPQ6501 MPQ6002, MPQ6502		40 100	DI DI DI DI DI DI DI DI DI DI DI DI DI D		(S.1)
$(I_C = 300 \text{ mAdc}, V_{CE} = 10 \text{ Vdc})$	MPQ6001, MPQ6501 MPQ6002, MPQ6502	ING BUT 112 (April 1	20 30	1 1 <u>2</u> 1 131 (5 <u>1-</u> 2)	8 <u>61</u> 8	

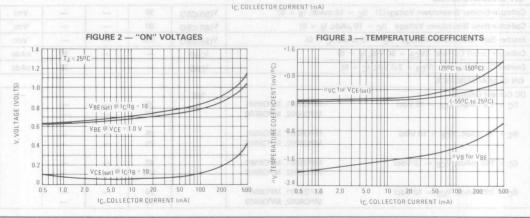
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	ObV	(16)	Symbol	Min	Тур	Max	Unit
Collector-Emitter Saturation Voltage(2)			VCE(sat)	VegV		agathoV as	Vdc
(I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 300 mAdc, I _B = 30 mAdc)	pbAqr.	600		pl I	auounitne	0.4 1.4	Callustor (
Base-Emitter Saturation Voltage(2) (IC = 150 mAdc, IB = 15 mAdc) (IC = 300 mAdc, IB = 30 mAdc)			VBE(sat)	_	_	1.3	Vdc
SMALL-SIGNAL CHARACTERISTICS						olingrasic 6:	OUR DE
Current-Gain — Bandwidth Product(2) (I _C = 50 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)		1.28	f _T .	200	350	on, N ar oson os	MPCIES
Output Capacitance $(V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 100 \text{ kHz})$		NP IPN	C _{obo}	1	6.0 4.5	8.0 8.0	PF PF
Input Capacitance $(V_{EB} = 2.0 \text{ Vdc}, I_{C} = 0, f = 100 \text{ kHz})$		NP IPN	C _{ibo}	19 1	20	30	pF
SWITCHING CHARACTERISTICS	SMiller	0.8	100			2004 28°C	a standi
Turn-On Time $(V_{CC} = 30 \text{ Vdc}, V_{BE} = 0.5 \text{ Vdc}, I_{C} = 150 \text{ mAdc},$		24	ton	+	30	91, 14PQ6003 32	ns
I _{B1} = 15 mAdc, Figure 1)	25	0814 pt	an la	TIT	Junction	and Storage	Sonrating.
Turn-Off Time $(V_{CC} = 30 \text{ Vdc}, I_C = 150 \text{ mAdc}, I_{B1} = I_{B2} = 15 \text{ mAdc})$			toff	-	225	agne2-atur	ns

NPN DATA

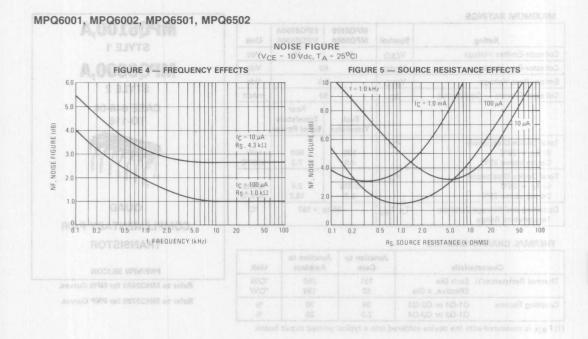
FIGURE 1 — NORMALIZED DC CURRENT GAIN





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





		Typ	
oleator Emitter Breakdown Voltaget2) (c) = 10 mAda, (g = 0)			
ollector Cutoff Current (VCR = 50 Vdc, Ig = 0)			
0c = 500 JANGS, VCE = 5.0 Vds)			
MALL BIONAL CHARACTERISTICS			

WAXIIVIOW RATINGS				100
Rating	Symbol	MPQ6100 MPQ6600	MPQ6100A MPQ6600A	Unit
Collector-Emitter Voltage	VCEO	40	45	Vdc
Collector-Base Voltage	VCBO	HGURE	60	Vdc
Emitter-Base Voltage	VEBO	5	5.0	Vdc
Collector Current — Continuous	IC	50		mAdc
100		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	0.825 6.7	2.4 19.2	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 t	o +150	°C

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit	
Thermal Resistance(1)	Each Die Effective, 4 Die	151 52	250 139	°C/W	
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	%	

(1) $R_{ heta JA}$ is measured with the device soldered into a typical printed circuit board.

MPQ6100,A

STYLE 1

MPQ6600,A

STYLE 2

CASE 646-06 TO-116



QUAD
COMPLEMENTARY PAIR
TRANSISTOR

PNP/NPN SILICON

Refer to MHQ2483 for NPN Curves. Refer to MHQ3798 for PNP Curves.

ELECTRICAL CHARACT	ERISTICS (TA =	25°C unless	otherwise n	oted.)
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Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	MPQ6100,6600 MPQ6100A,6600A	V(BR)CEO	40 45	=	_	Vdc
Collector-Base Breakdown Voltage (IC = 10 µAdc, IE = 0)		V(BR)CBO	60	-	-	Vdc
Emitter-Base Breakdown Voltage $(I_E = 10 \mu Adc, I_C = 0)$		V(BR)EBO	5.0	-	-	Vdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)		ІСВО	-	-	10	nAdc
ON CHARACTERISTICS(2)						
DC Current Gain (I _C = 100 μ Adc, V _{CE} = 5.0 Vdc)	MPQ6100,6600 MPQ6100A,6600A	hFE	50 100	=	=	-
(I _C = 500 μ Adc, V _{CE} = 5.0 Vdc)	MPQ6100,6600 MPQ6100A,6600A		75 150	=	=	
(I _C = 1.0 mAdc, V_{CE} = 5.0 Vdc)	MPQ6100,6600 MPQ6100A,6600A		75 150	=	=	
$(I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc})$	MPQ6100,6600 MPQ6100A,6600A		60 125	=		
Collector-Emitter Saturation Voltage ($I_C = 1.0 \text{ mAdc}, I_B = 100 \mu\text{Adc}$)		VCE(sat)	-	-	0.25	Vdc
Base-Emitter Saturation Voltage ($I_C = 1.0 \text{ mAdc}$, $I_B = 100 \mu \text{Adc}$)		VBE(sat)	_	_	0.8	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (I _C = 500 μ Adc, V _{CE} = 5.0 Vdc, f = 20 MHz)		fT	50	-	-	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)	PNP NPN	C _{obo}	=	1.2	4.0 4.0	pF

Characteristic		30	Symbol	Min	Тур	Max	Unit
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)	PNP NPN	40	C _{ibo}	SOV L	MFQ8416	8.0 8.0	pF
Noise Figure $(I_C = 100 \ \mu Adc, V_{CE} = 5.0 \ Vdc, R_S = 10 \ kohms, f = 10 \ Hz to 15.7 \ kHz, BW = 10 \ kHz)$	Vde	12 500	NF	vay T	4.0	egsa te V ear Lucent — t	dB

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%

OUAD DARLINGTON TRANS

)%.	Four Die Equal Power	Each Die	
		825	
			1) Second Breakdown occurs at power

THERMAL CHARACTERISTICS

		Urlector Emitter Breakdown Voltage(2) (IC = 10 mAdc, Ig = 0)
		ollector Cutoff Current (Vcg = 30 Vda, Ig = 6)
2.0		
		urrent-Gain — Bandwidth Product $\mathbb{E}_C \approx 10$ mArte, $\mathbb{V}_{CE} = 5.0$ Vdc, $t = 100$ MHz)
		out Capadiance Vag = 0.5 Vdc, ic = 0, f = 100 kHz)

Rating	Symbol	bol Value		Unit
Collector-Emitter Voltage MPQ6426 MPQ6427	V _{CEO}	ie nated.) Symbo	30 40	Vdc
Collector-Base Voltage MPQ6426 MPQ6427	V _{CBO}	Glbo	40 50	Vdc
Emitter-Base Voltage	VEBO	40	12	Vdc
Collector Current — Continuous	IC		500	mAdc
		Each Die	Four Die Equal Power	.86
Total Device Dissipation @ T _A = 25°C(1) Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	825 6.7	2400 19.2	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	- 55	to +150	°C

⁽¹⁾ Second Breakdown occurs at power levels greater than 3 times the power dissipation rating.

MPQ6426 MPQ6427

PPUCTOLA, MPG6666,A

CASE 646-06, STYLE 1 TO-116



QUAD DARLINGTON TRANSISTOR

NPN SILICON

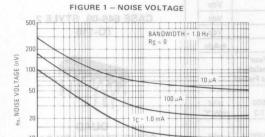
THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 139	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	%

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	MPQ6426 MPQ6427	V(BR)CEO	30 40	_	Vdc
Collector-Base Breakdown Voltage ($I_C = 100 \mu Adc, I_E = 0$)	MPQ6426 MPQ6427	V(BR)CBO	40 50	-	Vdc
Emitter-Base Breakdown Voltage (I _E = 10 µAdc, I _C = 0)		V _{(BR)EBO}	12		Vdc
Collector Cutoff Current (V _{CB} = 30 Vdc, I _E = 0)		СВО	_	100	nAdc
Emitter Cutoff Current (V _{BE} = 10 Vdc, I _C = 0)		IEBO	-	100	nAdc
ON CHARACTERISTICS(2)					
DC Current Gain (I _C = 10 mAdc, V _{CE} = 5.0 Vdc) (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)		hFE	5000 10,000	=	-
Collector-Emitter Saturation Voltage (I _C = 100 mAdc, I _B = 0.1 mAdc)		VCE(sat)	=	1.5	Vdc
Base-Emitter On Voltage (I _C = 100 mAdc, V _{CE} = 5.0 Vdc)		V _{BE(on)}	_	2.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 5.0 Vdc, f = 100 MHz)		fT	125	=	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 100 \text{ kHz}$)		C _{obo}		8.0	pF
Input Capacitance (VBE = 0.5 Vdc, I _C = 0, f = 100 kHz)		Cibo	-	15	pF

(2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.



f, FREQUENCY (Hz)

500 1.0 k 2.0 k 5.0 k 10 k 20 k 50 k 100 k

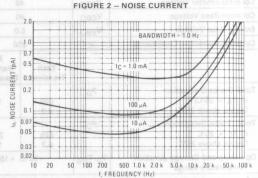
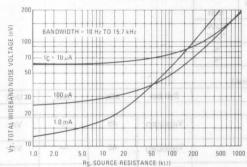
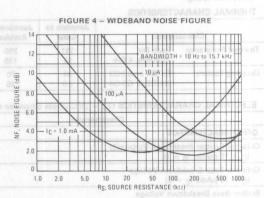


FIGURE 3 – TOTAL WIDEBAND NOISE VOLTAGE

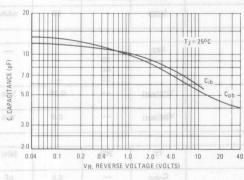
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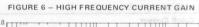


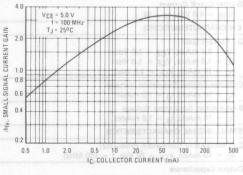


DYNAMIC CHARACTERISTICS

FIGURE 5 - CAPACITANCE







MPQ6501, MPQ6502 For Specifications, See MPQ6001 Data **MPQ6600,A**

For Specifications, See MPQ6100, A Data.

MAXIMUM RATINGS

MAXIMON NATINGS			A. T. 10 15 17 10 21	5 2017
Rating	Symbol	Value		Unit
Collector-Emitter Voltage	VCEO	40		Vdc
Collector-Base Voltage	VCBO		40	Vdc
Emitter-Base Voltage	VEBO		5.0	Vdc
Collector Current — Continuous	Ic	2	00	mAdc
		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ T _A = 25°C(1) Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	825 6.7	2400 19.2	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150		°C

⁽¹⁾ Second breakdown occurs at power levels greater than 3 times the power dissipation rating.

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 139	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	% %

MPQ6700

CASE 646-06, STYLE 2 TO-116



QUAD **COMPLEMENTARY PAIR TRANSISTOR**

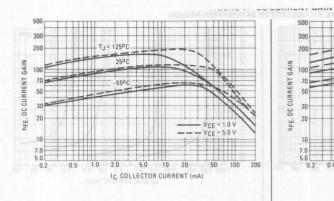
PNP/NPN SILICON

ELECTRICAL	CHARACTERISTICS	(TA =	25°C unless	otherwise	noted.)
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Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(2) (IC = 10 mAdc, I _B = 0)	V(BR)CEO	40		Vdc
Collector-Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	V(BR)CBO	40	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc$, $I_C = 0$)	V _{(BR)EBO}	5.0	_	Vdc
Collector Cutoff Current (VCB = 30 Vdc, I _E == 0) ON BURBLING NOTH = 8 BRUGH	СВО	ARAL OF	50	nAdc
Emitter Cutoff Current (VEB = 4.0 Vdc, I _C = 0)	IEBO	_	50	nAdc
ON CHARACTERISTICS(2)				
DC Current Gain (IC = 0.1 mAdc, VCE = 1.0 Vdc) (IC = 1.0 mAdc, VCE = 1.0 Vdc) (IC = 10 mAdc, VCE = 1.0 Vdc)	hFE	30 50 70	=	_
Collector-Emitter Saturation Voltage (IC = 10 mAdc, Ig = 1.0 mAdc)	VCE(sat)	ni T	0.25	Vdc
Base-Emitter Saturation Voltage (IC = 10 mAdc, I _B = 1.0 mAdc)	V _{BE} (sat)		0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS		Litter		
Current-Gain — Bandwidth Product(2) (IC = 10 mAdc, VCE = 20 Vdc, f = 100 MHz)	ET 10 C WALL	200	_	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 100 kHz)	C _{obo}	_	4.5	pF
Input Capacitance (VEB = 0.5 Vdc, I _C = 0, f = 100 kHz) PNP NPN	C _{ibo}	=	10 8.0	pF

⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.





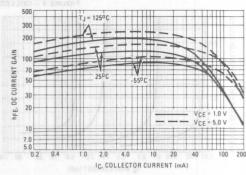
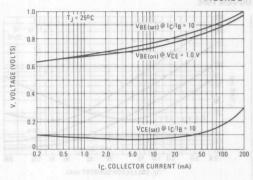


FIGURE 2 - "ON" VOLTAGE



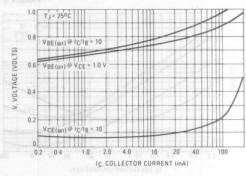
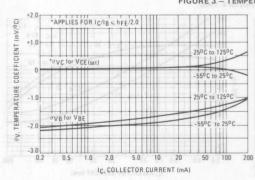
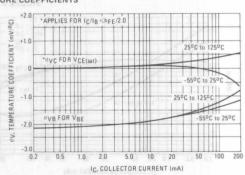


FIGURE 3 - TEMPERATURE COEFFICIENTS

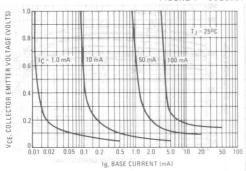




NPN

PNP

FIGURE 4 - COLLECTOR SATURATION REGION



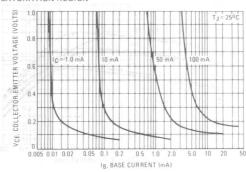
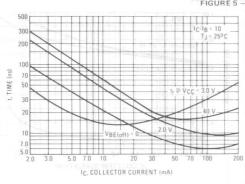


FIGURE 5 - TURN-ON TIME



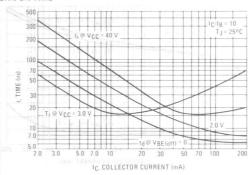
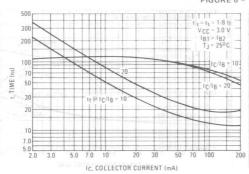
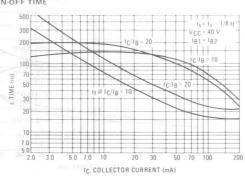


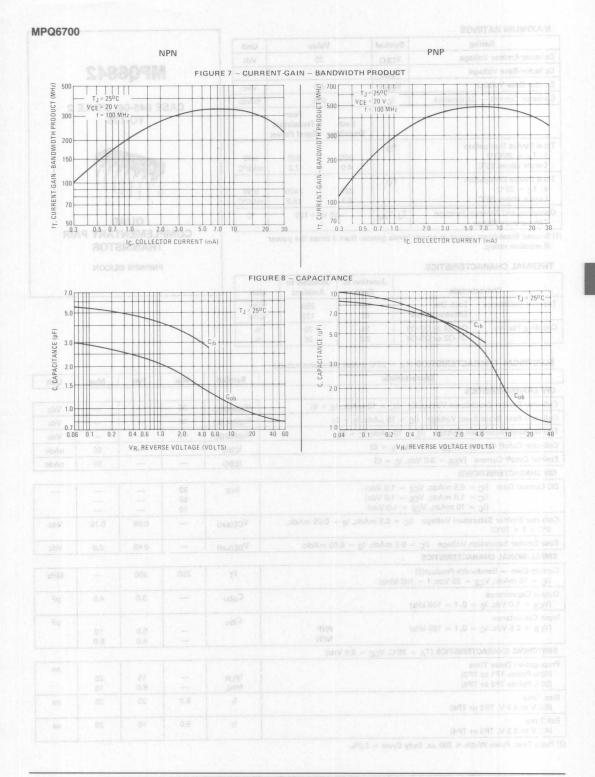
FIGURE 6 - TURN-OFF TIME





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Rating	Va	Unit		
Collector-Emitter Voltage VCEO		:	30	Vdc
Collector-Base Voltage	VCBO	N-HERVIOLA	30 - MIAD TWE	9 Vdc
Emitter-Base Voltage	VEBO	00 4	1.0	Vdc
Collector Current — Continuous	Ic	2	00	mAdc
		Each Transistor	Four Transistors Equal Power	
Total Device Dissipation @ TA = 25°C(1) Derate above 25°C	PD	500 4.0	900 7.2	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	825 6.7	2400 19.2	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 55 t	0 +150	°C

⁽¹⁾ Second Breakdown occurs at power levels greater than 3 times the power dissipation rating.

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	151 52	250 139	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	34 2.0	70 26	% %

MPQ6842

CASE 646-06, STYLE 2 TO-116



QUAD COMPLEMENTARY PAIR TRANSISTOR

PNP/NPN SILICON

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		- Jan			
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	30		_	Vdc
Collector-Base Breakdown Voltage (I _C = 10 μ Adc, I _E = 0)	V(BR)CBO	30	-	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	4.0	_	_	Vdc
Collector Cutoff Current (V _{CB} = 20 Vdc, I _E = 0)	СВО	0.56_	-	50	nAdc
Emitter Cutoff Current (VEB = 3.0 Vdc, IC = 0)	IEBO	_	_	50	nAdc
ON CHARACTERISTICS(2)					
DC Current Gain $(I_C = 0.5 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 1.0 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$ $(I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc})$	hFE	30 50 70		_	_
Collector-Emitter Saturation Voltage $\mbox{(IC} = 0.5 \mbox{ mAdc, I}_{\mbox{B}} = 0.05 \mbox{ mAdc, } \mbox{0°C} \ll T \ll 70 \mbox{°C} \mbox{)}$	V _{CE} (sat)	_	0.05	0.15	Vdc
Base-Emitter Saturation Voltage (I _C = 0.5 mAdc, I _B = 0.05 mAdc)	V _{BE(sat)}		0.65	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product(2) (I _C = 10 mAdc, V _{CE} = 20 Vdc, f = 100 MHz)	fT	200	350	_	MHz
Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_{E} = 0$, $f = 100 \text{ kHz}$)	C _{obo}	_	3.0	4.5	pF
Input Capacitance $(V_{\mbox{\footnotesize{EB}}} = 0.5 \mbox{ Vdc, I}_{\mbox{\footnotesize{C}}} = 0, \mbox{ f} = 100 \mbox{ kHz}) \\ \mbox{\footnotesize{NPN}}$	C _{ibo}		5.0 4.0	10 8.0	pF
switching characteristics (T _A = 25°C, V_{CC} = 5.0 Vdc)					
Propagation Delay Time (50% Points TP1 to TP3) (50% Points TP2 to TP4)	^t PLH ^t PHL	_	15 6.0	25 15	ns
Rise Time (0.3 V to 4.7 V, TP3 or TP4)	tr	5.0	25	35	ns
Fall Time (4.7 V to 0.3 V, TP3 or TP4)	tf	5.0	10	20	ns

⁽²⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

1.0 2.0

5.0 10 20

IC, COLLECTOR CURRENT (mA)

NPN

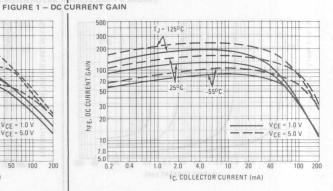
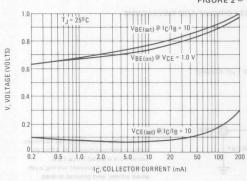
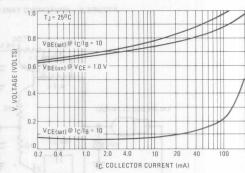


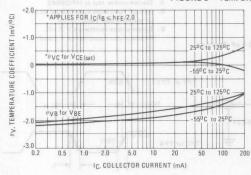
FIGURE 2 - "ON" VOLTAGE

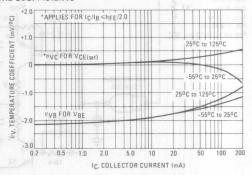




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FIGURE 3 - TEMPERATURE COEFFICIENTS



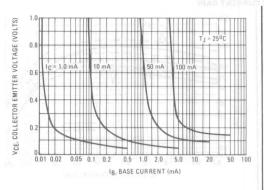


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NPN

PNP

FIGURE 4 - COLLECTOR SATURATION REGION



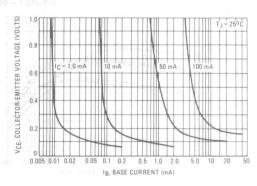
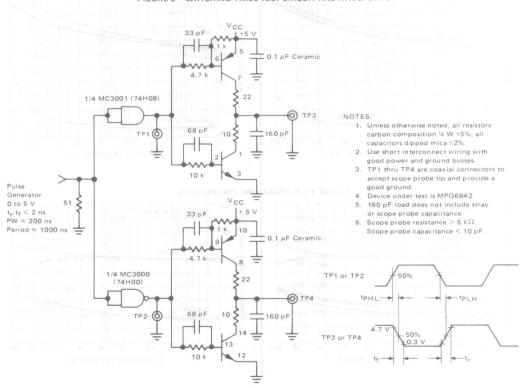


FIGURE 5 - SWITCHING TIMES TEST CIRCUIT AND WAVEFORMS



MAXIMUM RATINGS				- PINIS	
Rating	Symbol	MPQ7041	MPQ7042	MPQ7043	Unit
Collector-Emitter Voltage	VCEO	150	200	250	Vdc
Collector-Base Voltage	VCBO	150	200	250	Vdc
Emitter-Base Voltage	VEBO		5.0		Vdc
Collector Current — Continuous	Ic		500		mAdc
1 2 IVY2 26 212 2		Each Die		ur Die I Power	3
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	750 5.98		700	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	4.0	Will back	3.2	Watts mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}		-55 to +15	50	°C

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	100 39	167 73.5	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	46 5.0	56 10	%

MPQ7041 MPQ7042 MPQ7043

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPQ7051 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic Symbol

Minut Made Chara	cteristic	Symbol		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						80	RACTERIST	AHO R
	150 290 250	V(BR)CED	MPQ7041 MPQ7042 MPQ7043	V(BR)CEO	150 200 250	loV nivabile =\delta = =	imitter Bre 0 m/stc. lg	Vdc
	150 200 250	Vibricac	MPQ7041 MPQ7042 MPQ7043	V(BR)CBO	150 200 250	etioV rivolta = 0;=	šase Braziu 10 <i>µ</i> 0 1d c, lg	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)				V(BR)EBO	5.0		es S u akdo O zAdo, Ig	Vdc
Collector Cutoff Current $(V_{CB} = 120 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 150 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 180 \text{ Vdc}, I_{E} = 0)$			MPQ7041 MPQ7042 MPQ7043	ICBO	Ξ	10 = +0 = +0 = +0 =	100 100 100	nAdc = 80V/ = 80V/
ON CHARACTERISTICS		ossi				,	nemuO floor	O milin
DC Current Gain (IC = 1.0 mAdc, VCE = 10 Vdc) (IC = 10 mAdc, VCE = 10 Vdc) (IC = 30 mAdc, VCE = 10 Vdc)	25	340		hFE (SSV (25 40 40	45 60 80	or sex as trek m roar ob <u>di</u> se r	M CHAR
Collector-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)	as .		Children O.E.	VCE(sat)	$Q_{\overline{k}} = \frac{20}{30}V$, $q_{\overline{k}} = 20$	0.3	0.5	Vdc
Base-Emitter Saturation Voltage (I _C = 20 mAdc, I _B = 2.0 mAdc)		(tes)36V	Ade	V _{BE} (sat)	(1C = 30 r	0.7	0.9	Vdc
SMALL-SIGNAL CHARACTERISTICS						FISHER FARM	MUS THAT	GULLANS
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f =	= 100 MHz)	T		fT (see	50	80	y obani	MHz
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 M	Hz)	odev		C _{obo}	(5)-5(4)-5	2.5	5.0	pF
Input Capacitance (VEB = 3.0 Vdc, I _C = 0, f = 1.0 M	Hz)	odi		C _{ibo}	tsHt/4 0	40	50	pF

the second section and the	, OLU I				140
Collector-Base Voltage	VCBO	150	200	250	Vdc
Emitter-Base Voltage	VEBO		5.0		Vdc
Collector Current — Continuous	IC		500		mAdc
E SAE-SE STVLE :	CAS	Each Die	Е	Four Die qual Power	98
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	750 5.98	Mm 2MMm	1700 13.6	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.25 10	witt AVV 2ml Mm	3.2 25.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}		- 55 to	+ 150	°°C

THERMAL CHARACTERISTICS

Characteristic		Junction to Case	Junction to Ambient	Unit
Thermal Resistance	Each Die Effective, 4 Die	100 39	167 73.5	°C/W
Coupling Factors	Q1-Q4 or Q2-Q3 Q1-Q2 or Q3-Q4	46 5.0	56 10	%

MPQ7092 MPQ7093

CASE 646-06, STYLE 1 TO-116



QUAD AMPLIFIER TRANSISTOR

PNP SILICON

Refer to MPQ7051 for graphs.

ELECTRICAL	CHARACTERISTICS	(TA :	= 25°C	unless	otherwise	noted.)
------------	-----------------	-------	--------	--------	-----------	---------

Hest wild gy Char	acteristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						5-2	161 7	
Collector-Emitter Breakdown Voltage ($I_C = 1.0 \text{ mAdc}$, $I_B = 0$)	9e 03f 00S 08\$	OBBIEED	MPQ7091 MPQ7092 MPQ7093	V(BR)CEO	150 200 250	1 1 	=	Vdc
Collector-Base Breakdown Voltage (IC = 100 μ Adc, IE = 0)	150 200 250		MPQ7091 MPQ7092 MPQ7093	V(BR)CBO	150 200 250	=	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 100 \mu Adc, I_C = 0$)	9.8	089(95)V		V(BR)EBO	5.0	Ret The St	_	Vdc
Collector Cutoff Current (VCB = 120 Vdc, IE = 0) (VCB = 150 Vdc, IE = 0) (VCB = 180 Vdc, IE = 0)			MPQ7091 MPQ7092 MPQ7093	ICBO	_	=	250 250 250	nAdc
Emitter Cutoff Current (VBE = 3.0 Vdc, I _C = 0)		auri		IEBO			100	nAdc
ON CHARACTERISTICS	35					pri II n		
DC Current Gain $(I_C = 1.0 \text{ mAdc},$ $(I_C = 10 \text{ mAdc},$ $(I_C = 30 \text{ mAdc},$	VCE = 10 V	(dc)		hFE	25 35 25	40 55 50	=	71
Collector-Emitter Saturation Voltag	e (I _C = 20	mAdc, IB =	= 2.0 mAdc)	V _{CE(sat)}	-	0.3	0.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 20 \text{ mA}$	dc, IB = 2.0	mAdc)	V _{BE(sat)}		0.7	0.9	Vdc
SMALL-SIGNAL CHARACTERISTIC	S				20	e spendad		- Inte
Current-Gain — Bandwidth Product (I _C = 10 mAdc, V _{CE} = 20 Vdc, f		2)		fT	50	70		MHz
Output Capacitance (V _{CB} = 20 Vdc, I _E = 0, f = 1.0 M	MHz)	Cope		C _{obo}	EME	3.0	5.0	pF
Input Capacitance (VEB = 3.0 Vdc, I _C = 0, f = 1.0	MHz)	odi ^D		C _{ibo}	-	60	75	pF

MQ1120 F	or Specifications	, See MD1120F	Data.		
MQ2218,A	/MQ221	9,A For Spe	ecifications, See MD2218	,A,F,AF Da	ta.
MQ2369 F					
MQ2904/N	1Q2905/	A For Specifica	ations, See MD2904, A,F,	AF Data.	
MQ3251 F	or Specifications	See MD3250	A.F.AF Data.		
1100107					
MOOTOE		, See MD3467 I			
	State of the state	s, See MD3725,I			
MQ3762 F	or Specifications	, See MD3762,I	F Data.		
MQ6001/N	1Q6002	For Specification	ons, See MD6001,F Data	69	
		s, See MD7001,I	F Data.		
8407007					
MQ7007					
MQ7021 F					
MQ7021 F					
	or Specifications				
MQ7021 F	or Specifications	s, See MD7021,I			
MQ7021 F	or Specifications	s, See MD7021,I			
MQ7021 F	or Specifications	s, See MD7021,I			
MQ7021 F	or Specifications	s, See MD7021,I	F Data.		
MQ7021 F	or Specifications ### ### ############################	s, See MD7021,I	F Data.		
MQ7021 F	or Specifications old and det ass otherwise thesiana	s, See MD7021,1 lodmy8 Just ITAAA8	F Data.		
MQ7021 F	or Specifications ### ### ############################	s, See MD7021,I	F Data.		
MQ7021 F	or Specifications old and oet nest nes	s, See MD7021,1 lodmy8 Just ITAAA8	F Data.		
MQ7021 F sinu sinu sinu sinu sinu sinu sinu sinu	or Specifications 610 and 621 822 833 844 845 845 846 847	s, See MD7021,1 fodmy8 Just HALLS	F Data.		

MQ1129

CASE 607-04, STYLE 1



DUAL AMPLIFIER TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	SOLA, E.	Unit	
Collector-Emitter Voltage	VCEO	30		Vdc
Collector-Base Voltage	VCBO		60	Vdc
Emitter-Base Voltage	V _{EBO}		5.0	Vdc
Collector Current — Continuous	Ic	500		mAdc
		One Die	All Die Equal Power	F.081.F
Total Power Dissipation (a TA = 25°C Derate above 25°C	PD	400 2.28	600 3.42	mW/°C
Total Device Dissipation (a T _C = 25°C Derate above 25°C	PD	0.9 5.13	3.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-6	°C	

THERMAL CHARACTERISTICS

Characteristic	Symbol	One Die	All Die Equal Power	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	195	48.8	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}(1)$	438	292	°C/W
		Junction to Ambient	Junction to Case	
Coupling Factors				%
MQ1129 (Q1-Q2) (Q1-Q3 or Q1-Q4)		57 55	0	

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	V(BR)CEO 30 — — V(BR)CBO 60 — — V(BR)EBO 5.0 — — ICBO — — 10				
Collector-Emitter Breakdown Voltage(2) (I _C = 10 mAdc, I _B = 0)	V(BR)CEO	30	_	-	Vdc
Collector-Base Breakdown Voltage (I _C = 10 µAdc, I _E = 0)	V(BR)CBO	60	_	_	Vdc
Emitter-Base Breakdown Voltage ($I_E = 10 \mu Adc, I_C = 0$)	V(BR)EBO	5.0	=	_	Vdc
Collector Cutoff Current	ICBO				
$(V_{CB} = 50 \text{ Vdc}, I_{E} = 0)$ $(V_{CB} = 50 \text{ Vdc}, I_{F} = 0, T_{\Delta} = 150^{\circ}\text{C})$		_	_	10	nAdc μAdc
Emitter Cutoff Current	Irac			10	nAdc
$(V_{BE} = 3.0 \text{ Vdc}, I_{C} = 0)$	IEBO			10	HAdc

Characteristic	Symbol	Min	Тур	Max	Unit
ON CHARACTERISTICS					
DC Current Gain(2) (I _C = 10 µAdc, V _{CE} = 10 Vdc) (I _C = 100 µAdc, V _{CE} = 10 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc)	hFE	60 100 100 100	 120 140	300	_
Collector-Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc)	VCE(sat)		0.09	0.1	Vdc
Base-Emitter Saturation Voltage ($I_C = 10 \text{ mAdc}, I_B = 1.0 \text{ mAdc}$)	V _{BE} (sat)		0.7	0.85	Vdc
SMALL-SIGNAL CHARACTERISTICS				Wan.	
Current-Gain — Bandwidth Product(2) (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	fT	200	250	-	MHz
Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 100 kHz)	C _{obo}		3.5	8.0	pF
MATCHING CHARACTERISTICS (MD1129, MD1129F)		Buj n. E			
DC Current Gain Ratio(3) (IC = $100 \mu Adc$, VCE = $10 Vdc$) (IC = $1.0 mAdc$, VCE = $10 Vdc$)	hFE1/hFE2	0.9 0.9	Ī	1.0 1.0	_
Base-Emitter Voltage Differential (IC = 100 µAdc, VCE = 10 Vdc) (IC = 1.0 mAdc, VCE = 10 Vdc)	VBE1-VBE2	-	=	5.0 5.0	mVdd
Base-Emitter Voltage Differential Change Due to Temperature (I _C = 100 µAdc, V _{CE} = 10 Vdc, T _A = -55 to +25°C) (I _C = 100 µAdc, V _{CE} = 10 Vdc, T _A = +25 to +125°C)	Δ(V _{BE1} –V _{BE2})	=	=	0.8	mVdd

⁽¹⁾ R_{ØJA} is measured with the device soldered into a typical printed circuit board. (2) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%. (3) The lowest hFE reading is taken as hFE1 for this ratio.

		LEV ST. S. V.

te for coldered into a typical printed circuit beard.

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The data sheets on the following pages are designed to emphasize those FET's that by virtue of widespread industry use, ease of manufacture, and consequently low relative cost, merit first consideration for new equipment design. Package options from low-cost plastic to metal packages are available.

CAUTION:

Static electricity is a surface phenomenon which most commonly occurs when two dissimilar materials come into contact and then separate. Electro Static Discharge (ESD) damage of semiconductor components by operating personnel is quickly becoming a very prominent and significant problem. From simple bipolar designs to sensitive MOSFET structures, ESD has its unforgiving effect of degradation or destruction.

Motorola believes it is important to extend an emphasizing note of cautiousness when handling and testing ANY FET product. Precautions include, but are not limited to, the implementation of static safe workstations and proper handling techniques (see below). Additionally, it is very important to keep FET devices in their antistatic shipping containers and away from any staticgenerating materials.

HANDLING CONSIDERATIONS:

MOS Field-Effect Transistors, due to their extremely high input resistance, are subject to potential damage by the accumulation of excess static charge. To avoid possible damage to the devices while handling, testing, or in actual operation, the following procedure should be followed:

- 1. The leads of the devices should remain wrapped in the shorting spring except when being tested or in actual operation to avoid the build-up of static charge.
- 2. Avoid unnecessary handling; when handled, the devices should be picked up by the can instead of the leads.
- 3. The devices should not be inserted or removed from circuits with the power on as transient voltages may cause permanent damage to the devices.

Field-Effect **Transistors**

6-1

6

2N2843 2N2844

CASE 22-03, STYLE 12 TO-18 (TO-206AA)





JFET GENERAL PURPOSE

P-CHANNEL — DEPLETION

Symbol

VDS

VDG

VGS

ID

PD

Tstg

Value

30

30

30

50

300

1.7

-60 to +200°C

Unit

Vdc

Vdc

Vdc

mA

mW

mW/°C

°C

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (I _G = 1.0 μA)	50.468 3	V(BR)GSS	30	_	Vdc
Gate Reverse Current (VGS = 5.0 V)		ISON IGSS	1 10	10	nA
Gate Source Cutoff Voltage $(V_{DS} = -5.0 \text{ V, } I_{D} = -1.0 \mu\text{A})$		VGS(off)		1.7	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current $(V_{DS} = -5.0 \text{ V})$	2N2843 2N2844	IDSS*	200 440	1000 2200	μΑ
SMALL-SIGNAL CHARACTERISTICS	damage of	(CES) signado	giCl pdst8 m.	i, Resign	en, chill
Forward Transfer Admittance $(V_{DS} = -5.0 \text{ V}, f = 1.0 \text{ kHz})$	2N2843 2N2844	Yfs *	540 1400	10 10 12 10 10 10 10 10 10 10 10 10 10 10 10 10	μmhos
Input Capacitance $(V_{DS} = -5.0 \text{ V}, V_{GS} = 1.0 \text{ V}, f = 140 \text{ kHz})$	2N2844	AA grataet be	o pres er ant de	17 30	pF
FUNCTIONAL CHARACTERISTICS		ant of the time			1 1 1 1
Noise Figure $(V_{DS} = -5.0 \text{ V}, f = 1.0 \text{ kHz}, R_{G} = 1.0 \text{ meg})$	ET devices	NF	gmi vitav e. h	3.0	dB
Pulas Width = 620 ma Duty Cycle 100/	- Children Children	Contract of the Contract of th			

^{*}Pulse Width ≤ 630 ms, Duty Cycle = 10%.

MAXIMUM RATINGS

Drain-Source Voltage

Drain-Gate Voltage

Drain Current

Gate-Source Voltage

Derate above 25°C

Storage Temperature Range

Rating

Total Device Dissipation @ TA = 25°C

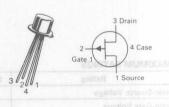
2N3331 CASE 20-03, STYLE 5 TO-72 (TO-206AF)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	abV 20	05 Vdc
Reverse Gate-Source Voltage	VGSR	20	05 Vdc
Gate Current	IG	obV 10	11 mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	0.3 1.7	Watts mW/°C
Storage Temperature Range	T _{stg}	-65 to +200	01 8°C

2N3330

CASE 20-03, STYLE 5 TO-72 (TO-206AF)



JFET AMPLIFIER

P-CHANNEL — DEPLETION

Refer to 2N5460 for graphs.

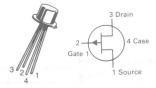
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS				CTERISTICS	RAND TO
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)		V(BR)GSS	20	Breskown (A)	Vdc
Gate Reverse Current (VGS = 10 Vdc, VDS = 0) (VGS = 10 Vdc, VDS = 0, TA = 150°C)		IGSS		10 10	nAdc μAdc
ON CHARACTERISTICS			(Au 07	- = n(N B)	= 20V)
Zero-Gate-Voltage Drain Current(1) (Vps = -10 Vdc, Vgs = 0)		IDSS	2.0	6.0	mAdc
Gate-Source Voltage (V _{DG} = -15 Vdc, I _D = 10 μAdc)		VGS	T(V 0	6.0	Vdc
Drain-Source Resistance (I _D = 100 μAdc, V _{GS} = 0)		rDS	- 10	800	Ohms
SMALL-SIGNAL CHARACTERISTICS			ONTOHAN.	DESCRIPTION OF THE	ACCULATION
Forward Transfer Admittance(1) $ (V_{DS} = -10 \text{ Vdc}, I_D = 2.0 \text{ mAdc}, f = 1.0 \text{ kHz}) $ $ (V_{DS} = -10 \text{ Vdc}, I_D = 2.0 \text{ mAdc}, f = 10 \text{ MHz}) $		Yfs	1500 1350	3000	μmhos
Output Admittance $(V_{DS} = -10 \text{ Vdc}, I_{D} = 2.0 \text{ mAdc}, f = 1.0 \text{ kHz})$		Yos	eoni	40 mmt A ratao	μ mhos
Reverse Transfer Conductance (Vps = -10 Vdc, Ip = 2.0 mAdc, f = 1.0 kHz)		Yrs	1,000	0.1	μmhos
Input Conductance ($V_{DS} = -10 \text{ Vdc}$, $I_{D} = 2.0 \text{ mAdc}$, $f = 1.0 \text{ kHz}$)		Yis	ENISTRUS	0.2	μmhos
Input Capacitance (Vps = -10 Vdc, Vgs = 1.0 Vdc, f = 1.0 MHz)	(\$H8 0.F + 1	C _{iss}	-1.0 mA, Rg	20 = Q V 0.8	pF
FUNCTIONAL CHARACTERISTICS		.800	ty Gyde ≤ 10	= 300 µs, Du	MbjW es
Noise Figure $(V_{DS} = -5.0 \text{ Vdc}, I_{D} = 1.0 \text{ mAdc}, R_{G} = 1.0 \text{ Megohm}, f = 1.0 \text{ magohm}$	1.0 kHz)	NF	-	3.0	dB

(1) Pulse Test: Pulse Width ≤ 630 ms, Duty Cycle ≤ 10%.

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	obV 20	○ Vdc
Drain-Gate Voltage	V _{DG}	sbV 20	○S Vdc
Gate-Source Voltage	VGS	20 Am 20	○ Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	235 V 300 2 V 1.7	mW/°C
Storage Temperature Range	T _{stg}	-65 to +200	or °°C

CASE 20-03, STYLE 5 TO-72 (TO-206AF)



JFET LOW-FREQUENCY

P-CHANNEL — DEPLETION

Refer to 2N5460 for graphs.

Nier Wax Linit	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (I _G = 10 μA)	220(98)\	V(BR)GSS	20		Vdc
Gate Reverse Current (VGS = 10 V, VDS = 0)	aepi	lGSS	_ 10	10	nA
Gate Source Cutoff Voltage $(V_{DS} = -15 \text{ V}, I_{D} = -10 \mu\text{A})$		VGS(off)		8.0	Vdc
ON CHARACTERISTICS	550		Maria Cara		
Zero-Gate-Voltage Drain Current (VDS = -10 V, VGS = 0 V)	897	I _{DSS} *	-5.0	- 15.0	mA
Drain-Source Resistance (I _D = -100μ A, V _{GS} = 0)	501	rDS	_	800	ohms
SMALL-SIGNAL CHARACTERISTICS	3		practicitus an	A works	and a selection
Forward Transfer Admittance (VDS = -10 V, ID = -5.0 mA, f	= 1.0 kHz)	Vfs *	2000	4000	μmhos
Output Admittance (VDS = -10 V, ID = -2.0 mA, f	= 1.0 kHz)	yos *	Lotatin II.	100	μmhos
Forward Transfer Admittance $(V_{DS} = -10 \text{ V}, I_{D} = -2.0 \text{ mA}, f$	= 10 MHz)	Yfs*	1350	- p 1 3	μmhos
Input Capacitance (V _{DS} = -10 V, V _{GS} = 1.0 V, f =	1.0 MHz)	Ciss	ot / -	20	pF
FUNCTIONAL CHARACTERISTICS	1816	= 1,0 kHz)	Labert U.	- 71 - 72 - 1	
Noise Figure $(V_{DS} = -5.0 \text{ V}, I_{D} = -1.0 \text{ mA}, F$	$R_{\rm G} = 1.0 \mathrm{M}\Omega$, $f = 1.0 \mathrm{kHz}$	NF (*HW) (1.1)		4.0	dB

^{*}Pulse Width \leq 300 μ s, Duty Cycle \leq 10%.

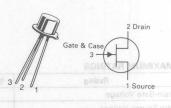
2N3459 2N3460 CASE 22-03, STYLE TO-18 (TO-205AA)

MAXIMUM RATINGS

III DAINIGO I I DAINIGO			
Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	50	Vdc
Gate-Source Voltage	VGS	50	Vdc
Gate Current OMETO BEEN OF	IG	10	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.7	mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +200	°C

2N3437 2N3438

CASE 22-03, STYLE 4 TO-18 (TO-206AA)



JFET LOW-FREQUENCY

N-CHANNEL - DEPLETION

ELECTRICAL	. CHARACTERISTICS	(TA =	25°C unless	otherwise n	noted.)
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Ch	Characteristic				Max	Unit
OFF CHARACTERISTICS	Hogaryd		DELTE (DVDIO VIII)		DAMES SANCES	SEC. 212. 22
Gate-Source Breakdown Voltage $(I_G = 1.0 \mu A)$	герінеі У		V(BR)GSS	50 egatio	Breakdown	Vdc
Gate Reverse Current (VGS = -30 V)	asal		IGSS	-	0.5	nA
Gate Source Cutoff Voltage (V _{DS} = 20 V, I _D = 1.0 nA)	MojšeV	2N3437 2N3438	VGS(off)	= (A ₃)	5.0 2.5	Vdc squoe els (S = 20V)
Gate Source Voltage (V _{DS} = 20 V, I _D = 1.0 μA)	*aeni	2N3437 2N3438	V _G S		4.8	Vdc Vests2-on
ON CHARACTERISTICS		202459			(allo)	1VDS = 20
Zero-Gate-Voltage Drain Current (V _{DS} = 20 V)		2N3437	I _{DSS} *	0.8		mA
CANALL CICNAL CHAPACTERISTICS	"left"	2N3438			stimul.0 stei	
SMALL-SIGNAL CHARACTERISTICS		29/3/60		2000		_
Forward Transfer Admittance (VDS = 20 V, f = 1.0 kHz)		2N3437 2N3438	Yfs	1500 800	6000 4500	μmhos
Output Admittance (V _{DS} = 30 V, f = 1.0 kHz)	Ciss	2N3437 2N3438	y _{os}	=	20 5.0	μmhos
Input Capacitance (VDS = 10 V)	Coss		C _{iss}		18	pF
(V _{DS} = 6.0 V) (V _{DS} = 4.0 V, f = 1.0 MHz)					CHARACTE	MCTIONA oise Figure
FUNCTIONAL CHARACTERISTICS		2143453	(f2lv	8g = 1.0	V, f = 20 Hz	-
Noise Figure (VDS = 10 V, R _G = 1.0 m Ω , f = 1.	0 kHz)	2N3460	NF	ty Cycle ≤	2.0 pd am 001 a	dB risio Wideh

^{*}Pulse Width ≤ 630 ms, Duty Cycle ≤ 10%.

2N3438

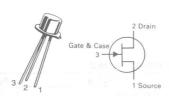
CASE 22-03, STYLE

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	50	Vdc
Gate-Source Voltage	VGS	50	Vdc
Gate Current	IG	10	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.7	mW mW/°C
Storage Temperature Range	T _{sta}	-65 to +200	°C

2N3459 2N3460

CASE 22-03, STYLE 4 TO-18 (TO-206AA)



JFET LOW-FREQUENCY/ LOW NOISE

N-CHANNEL — DEPLETION

Ch	aracteristic		Symbol	Min	Max	Unit		
OFF CHARACTERISTICS	TICS							
Gate-Source Breakdown Voltage (IG = 1.0 μ A)	SSUMMY		V(BR)GSS	-50	_	Vdc		
Gate Reverse Current (VGS = -30 V)	250		IGSS	_	-0.25	nA		
Gate Source Cutoff Voltage ($V_{DS} = 20 \text{ V}, I_{D} = 1.0 \mu\text{A}$)	(110)55)	2N3459 2N3460	VGS(off)		- 3.4 - 1.8	Vdc		
ON CHARACTERISTICS	SBA	2343487		1790 13	9.1			
Zero-Gate-Voltage Drain Current (V _{DS} = 20 Volts)			polts) 2N3459 0.8				4.0	mA
SMALL-SIGNAL CHARACTERISTICS	580	2N3437				1.1		
Forward Transfer Admittance (V _{DS} = 20 Volts, f = 1.0 kHz)		2N3459 2N3460	Yfs *	1500 800	6000 4500	μmhos		
Output Admittance $(V_{DS} = 30 \text{ Volts}, f = 1.0 \text{ kHz})$	18131	2N3459 2N3460	Yos	_	20 5.0	μmhos		
Input Capacitance (VDS = 10 V)	iyosi	2 N3437 2 N3438	C _{iss}	- 63	18	pF		
Output Capacitance (V _{DS} = 30 V)	Giss		C _{oss}	_	5.0	pF		
FUNCTIONAL CHARACTERISTICS			,					
Noise Figure ($V_{DS} = 10 \text{ V}, f = 20 \text{ Hz}, R_G = 1.0 \text{ I}$	MΩ)	2N3459 2N3460	NF NF	200 TSM	4.0 4.0	dB		

^{*}Pulse Width \leqslant 100 ms, Duty Cycle \leqslant 10%.

2N3796 2N3797

CASE 22-03, STYLE 2 TO-18 (TO-206AA)





MOSFET LOW-POWER AUDIO

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

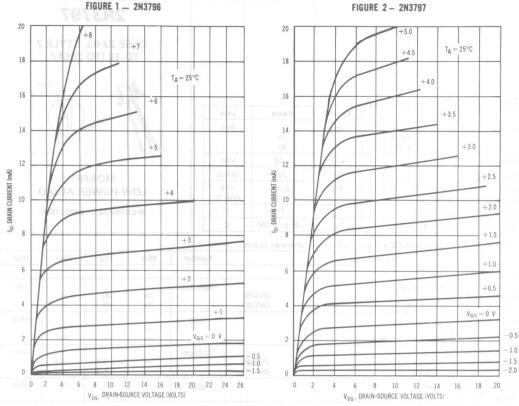
Rating		Symbol	Value	Unit
Drain-Source Voltage	2N3796 2N3797	V _{DS}	25 20	Vdc
Gate-Source Voltage		VGS	±10	Vdc
Drain Current		ID	20	mAdc
Total Device Dissipation Derate above 25°C	@ T _A = 25°C	PD	PD 200 1.14	
Junction Temperature Ra	ange	TJ	+ 175	°C
Storage Channel Temper	rature Range	T _{stg}	-65 to +200	°C

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						9
Drain-Source Breakdown Voltage $(V_{GS} = -4.0 \text{ V}, I_{D} = 5.0 \mu\text{A})$ $(V_{GS} = -7.0 \text{ V}, I_{D} = 5.0 \mu\text{A})$	2N3796 2N3797	V(BR)DSX	25 20	30 25		Vdc
Gate Reverse Current(1) (VGS = -10 V, VDS = 0) (VGS = -10 V, VDS = 0, TA = 150°C)		IGSS			1.0	pAdc
Gate Source Cutoff Voltage (Ip = $0.5 \mu A$, Vps = $10 V$) (Ip = $2.0 \mu A$, Vps = $10 V$)	2N3796 2N3797	VGS(off)		-3.0 -5.0	-4.0 -7.0	Vdc
Drain-Gate Reverse Current(1) (VDG = 10 V, IS = 0)		IDGO	RE -SE B 30/17/04/30/8	8 ±0 1 Vos DANIVEO	1.0	pAdc
ON CHARACTERISTICS		Charles and				
Zero-Gate-Voltage Drain Current (V _{DS} = 10 V, V _{GS} = 0)	2N3796 2N3797	IDSS	0.5 2.0	1.5 2.9	3.0 6.0	mAdc
On-State Drain Current $(V_{DS} = 10 \text{ V}, V_{GS} = +3.5 \text{ V})$	2N3796 2N3797	I _D (on)	7.0 9.0	8.3 14	14 18	mAdc
SMALL-SIGNAL CHARACTERISTICS	UHO MOREWART O	эливо момма			Territor.	1
Forward Transfer Admittance (VDS = 10 V, VGS = 0, f = 1.0 kHz)	2N3796 2N3797	Yfs	900 1500	1200 2300	1800 3000	μmhos
$(V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1.0 \text{ MHz})$	2N3796 2N3797		900 1500		ev —	H. 5
Output Admittance $(V_{DS} = 10 \text{ V}, V_{GS} = 0, f = 1.0 \text{ kHz})$	2N3796 2N3797	Yos	Ξ	12 27	25 60	μmhos
Input Capacitance (V _{DS} = 10 V, V _{GS} = 0, f = 1.0 MHz)	2N3796 2N3797	C _{iss}	=	5.0 6.0	7.0 8.0	pF
Reverse Transfer Capacitance (Vps = 10 V, Vgs = 0, f = 1.0 MHz)	4 I	C _{rss}		0.5	0.8	pF
FUNCTIONAL CHARACTERISTICS			1-11111	LIB.		- 8-
Noise Figure (VDS = 10 V, VGS = 0, f = 1.0 kHz, RS = 3 megohms)		NF		3.8		dB

⁽¹⁾ This value of current includes both the FET leakage current as well as the leakage current associated with the test socket and fixture when measured under best attainable conditions.



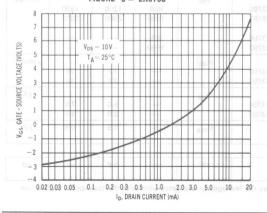


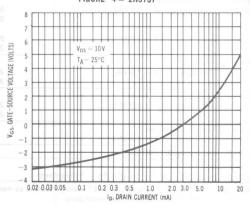


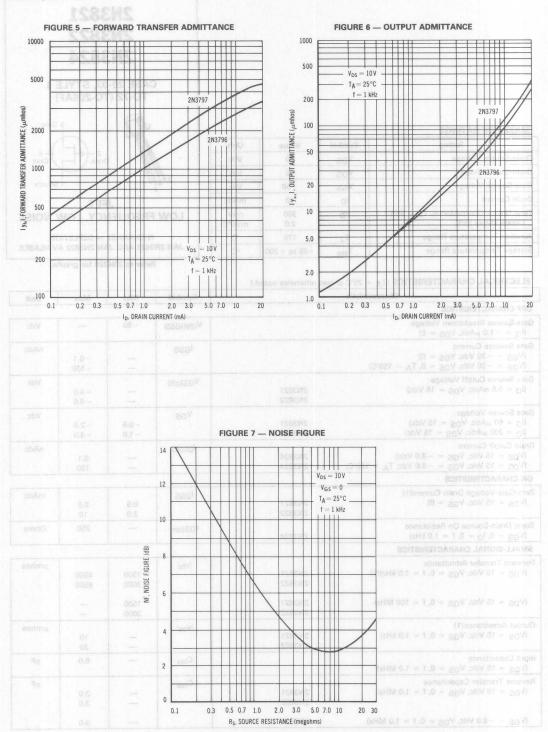
COMMON SOURCE TRANSFER CHARACTERISTICS

FIGURE 3 - 2N3796

FIGURE 4 - 2N3797







MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

2N3821 2N3822 2N3824

CASE 20-03, STYLE 1 TO-72 (TO-206AF)





JFET LOW FREQUENCY, LOW NOISE

N-CHANNEL — DEPLETION
JAN 2N3821 AND JAN 2N3822 AVAILABLE

Refer to 2N4220 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	50	Vdc
Drain-Gate Voltage	V _{DG}	50	Vdc
Gate-Source Voltage	VGS	-50	Vdc
Drain Current	ID	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	= 25°C P _D 300 2.0		mW mW/°C
Junction Temperature Range	TJ	175	°C
Storage Temperature Range	T _{stg}	-65 to +200	°C

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	V 0 10 20 0,)	0.0 0.0 0.5 (April 1981)	BI NO ALC		
Gate-Source Breakdown Voltage (I _G = -1.0 µAdc, V _{DS} = 0)	V _(BR) GSS	- 50	_	Vdc	
Gate Reverse Current $(V_{GS} = -30 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -30 \text{ Vdc}, V_{DS} = 0, T_{A} = 150^{\circ}\text{C})$	IGSS	=	-0.1 100	nAdc	
Gate Source Cutoff Voltage (ID = 0.5 nAdc, V _{DS} = 15 Vdc)	V _{GS(off)}	_	-4.0 -6.0	Vdc	
Gate Source Voltage (ID = 50 μ Adc, VDS = 15 Vdc) (ID = 200 μ Adc, VDS = 15 Vdc)	2N3821 3N3822 W - Y 3RU09	V _{GS}	- 0.5 - 1.0	-2.0 -4.0	Vdc
Drain Cutoff Current $(V_{DS} = 15 \text{ Vdc}, V_{GS} = -8.0 \text{ Vdc})$ $(V_{DS} = 15 \text{ Vdc}, V_{GS} = -8.0 \text{ Vdc}, T_{A} = 150^{\circ}\text{C})$	2N3824 2N3824	ID(off)	=	0.1 100	nAdc
ON CHARACTERISTICS	- 20/	1-1-1			
Zero-Gate-Voltage Drain Current(1) (V _{DS} = 15 Vdc, V _{GS} = 0)	2N3821	IDSS	0.5 2.0	2.5 10	mAdc
Static Drain-Source On Resistance (VGS = 0, ID = 0, f = 1.0 kHz)	2N3824	rDS(on)	_	250	Ohms
SMALL-SIGNAL CHARACTERISTICS			8		
Forward Transfer Admittance (VDS = 15 Vdc, VGS = 0, f = 1.0 kHz)(1)	2N3821 2N3822	yfs	1500 3000	4500 6500	μmhos
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100 \text{ MHz})$	2N3821 2N3822		1500 3000	_	
Output Admittance(1) $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$	2N3821 2N3822	Yos	_	10 20	μmhos
Input Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)		C _{iss}	_	6.0	pF
Reverse Transfer Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0 MHz)	2N3821 2N3822	C _{rss}	_	3.0 3.0	pF
$(V_{GS} = -8.0 \text{ Vdc}, V_{DS} = 0, f = 1.0 \text{ MHz})$	6.5 6.6 0.6 0.1 5 0.20 (am/ 2N3824 Tal239 30m/02 .gs		_	3.0	

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic Characteristic	Characteristic			Max	Unit	
FUNCTIONAL CHARACTERISTICS						
Noise Figure $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, R_S = 1.0 \text{ megohm}, f = 10 \text{ Hz}, \text{ Noise Bandwidth} = 5.0 \text{ Hz})$	2N3821, 2N3822	NF		5.0	dB	
Equivalent Input Noise Voltage (V _{DS} = 15 Vdc, V _{GS} = 0, f = 10 Hz, Noise Bandwidth = 5.0 Hz)	2N3821, 2N3822	en		200	nv/Hz ^{1/2}	

(1) Pulse Test: Pulse Width ≤ 100 ms, Duty Cycle ≤ 10%.

	W/m PW/Wm

Before to SMARIS for species

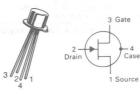
VHF AMPLIFIER

		Max	
N CHARACTERITIES			
everse fransfer Cepsoitance (Vps - 15 Vdc, Vps - 0, f = 1,0 MHz)			

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	30	Vdc
Drain-Gate Voltage	V _{DG}	30	Vdc
Gate-Source Voltage	VGS	-30	Vdc
Gate Current	IG	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 2.0	mW mW/°C
Junction Temperature Range	TJ	175	°C
Storage Temperature Range	T _{stq}	-65 to +200	°C

2N3823

JAN, JANTX AVAILABLE CASE 20-03, STYLE 1 TO-72 (TO-206AF)



JFET VHF AMPLIFIER

N-CHANNEL — DEPLETION

Refer to 2N4416 for graphs.

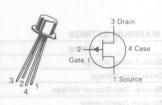
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Gate-Source Breakdown Voltage (IG = $-1.0 \mu Adc$, VDS = 0)	V(BR)GSS	- 30	_	Vdc
Gate Reverse Current $(V_{GS} = -20 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -20 \text{ Vdc}, V_{DS} = 0, T_A = 150^{\circ}\text{C})$	IGSS		- 0.5 - 500	nAdc
Gate Source Cutoff Voltage (I _D = 0.5 nAdc, V _{DS} = 15 Vdc)	VGS(off)	-	-8.0	Vdc
Gate Source Voltage (ID = 0.4 mAdc, VDS = 15 Vdc)	V _G s	-1.0	-7.5	Vdc
ON CHARACTERISTICS				
Zero-Gate-Voltage Drain Current(1) (Vps = 15 Vdc, Vqs = 0)	IDSS	4.0	20	mAdc
SMALL-SIGNAL CHARACTERISTICS				
Forward Transfer Admittance $(V_{DS}=15\ Vdc,V_{GS}=0,f=1.0\ kHz)(1)$ $(V_{DS}=15\ Vdc,V_{GS}=0,f=200\ MHz)$	Yfs	3500 3200	6500	μmhos
Input Admittance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 200 MHz)	Re(yis)	_	800	μmhos
Output Conductance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})(1)$ $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 200 \text{ MHz})$	yos Re(yos)	_	35 200	μmhos
Input Capacitance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ MHz})$	C _{iss}	_	6.0	pF
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	C _{rss}	_	2.0	pF
FUNCTIONAL CHARACTERISTICS				
Noise Figure (Vps = 15 Vdc, Vqs = 0, Rs = 1000 ohms, f = 100 MHz)	NF	_	2.5	dB

⁽¹⁾ Pulse Test: Pulse Width = 100 ms, Duty Cycle ≤ 10%.

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	-20	Vdc
Drain-Gate Voltage	V _{DG}	-20	Vdc
Reverse Gate-Source Voltage	VGSR	20	Vdc
Forward Gate Current	IGF	10	mAdc
Forward Gate-Source Voltage	VGSF	20	Vdc Vdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 000 4	mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +200	°C

2N3909 2N3909A

CASE 20-03, STYLE 5 TO-72 (TO-206AF)



JES - AT JET SQUEET **AMPLIFIER**

P-CHANNEL — DEPLETION

Refer to 2N5460 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) (1)

Characteristi	С		Symbol	Min	Max	Unit
OFF CHARACTERISTICS			10000	44 AP	1	
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)		(3°081 =	V _(BR) GSS	20		Vdc
Gate Reverse Current			IGSS	06 = 20 Vau		
$(V_{GS} = 10 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = 10 \text{ Vdc}, V_{DS} = 0, T_{A} = 100^{\circ}\text{C})$	2N3970	. (3	An O.T = OI.	os = 20 Vac	1.0	nAdc μAdc
Gate Source Cutoff Voltage			VGS(off)			Vdc
$(V_{DS} = -10 \text{ Vdc}, I_{D} = 10 \mu \text{Adc})$		2N3909 2N3909A			8.0 8.0	ARAHS ME
Gate Source Voltage (VDS = -10 Vdc, ID = $30 \mu Adc$)	2N3971	(0) = (3DV)	VGS	0.3	7.9	Vdc
ON CHARACTERISTICS	r ntototo		A second relation	w 20 - all		
Zero-Gate-Voltage Drain Current(2) (VDS = -10 Vdc, VGS = 0)	2N3971 · 2N3973	2N3909	IDSS	0.3	15	mAdc
		2N3909A	Shaw of Land	1.0	15	mired I mired
SMALL-SIGNAL CHARACTERISTICS						
Forward Transfer Admittance(2)	2143972		Vfs			μmhos
$(V_{DS} = -10 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$		2N3909		1000	5000	WALL-SIG
		2N3909A	.0 - 01.0 -	2200	5000	rain-Sourc
$(V_{DS} = -10 \text{ Vdc}, V_{GS} = 0, f = 10 \text{ MHz})$		2N3909 2N3909A		900 2000		
Output Admittance (V _{DS} = -10 Vdc, V _{GS} = 0, f = 1.0 kHz)	(2)	.0 WHz) 12 Voc. f = 1.0 MI	yos	= 20 Voc. \ anne (Vos	100	μmhos
Input Capacitance			Ciss	RISTIGS	CHARACTE	pF
$(V_{DS} = -10 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ MHz})$	2033970	2N3909 2N3909A	trien for 2N397	Test Conc	32 9.0	nQ-nw amiT vrla
Reverse Transfer Capacitance (V _{DS} = -10 Vdc, V _{GS} = 0, f = 1.0 MHz)	2N3971 2N3972	2N3909	C _{rss}	(no)(g)	16	pF
		2N3909A	nion for 2M210	Test Cond	3.0	

(1) The fourth lead (case) is connected to the source for all measurements.
(2) Pulse Test: Pulse Width ≤ 630 ms, Duty Cycle ≤ 10%.

2N3909 2N3909A

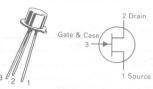
CASE 20-03, STYLE 5 TO-72 (TO-205AE)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	40	Vdc
Drain-Gate Voltage	V _{DG}	40	Vdc
Reverse Gate-Source Voltage	VGSR	40	Vdc
Forward Gate Current	IGF	50	mAdc
Total Device Dissipation @ $T_A = 25$ °C Derate above 25 °C	PD	1.8 obV 10	Watts mW/°C
Storage Temperature Range	T _{stg}	-65 to +200	°C

2N3970 2N3971 2N3972

CASE 22-03, STYLE 4 TO-18 (TO-206AA)



JFET SWITCHING N-CHANNEL — DEPLETION

	FLECTRICA!	CHARACTERISTICS	(TA = 25°C unless otherwise noted
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Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (I _G = 1.0 μAdc, V _{GS} = 0)	sawestite and	V _(BR) GSS	40	NE DE LA COMPANSION DE	Vdc
Gate Reverse Current (VGS = 20 Vdc, VDS = 0)		IGSS	-	250	pAdc
Drain Reverse Current $(V_{DG} = 20 \text{ Vdc}, I_{S} = 0)$ $(V_{DG} = 20 \text{ Vdc}, I_{S} = 0, T_{A} = 150^{\circ}\text{C})$		DGO		250 500	pAdc nAdc
Drain Cutoff Current $(V_{DS}=20\ Vdc,\ V_{GS}=-12\ Vdc)$ $(V_{DS}=20\ Vdc,\ V_{GS}=-12\ Vdc,\ T_A=150^\circ C)$		ID(off)	_	250 500	pAdc nAdc
Gate Source Voltage (V _{DS} = 20 Vdc, I _D = 1.0 nAdc)	2N3970 2N3971 2N3972	VGS	4.0 2.0 0.5	10 5.0 3.0	Vdc
ON CHARACTERISTICS			Milesa Or	The second	201
Zero-Gate-Voltage Drain Current(1) (V _{DS} = 20 Vdc, V _{GS} = 0)	2N3970 2N3971 2N3972	IDSS	50 25 5.0	150 75 30	mAdc
Drain-Source On-Voltage $(I_D=20 \text{ mAdc}, V_{GS}=0)$ $(I_D=10 \text{ mAdc}, V_{GS}=0)$ $(I_D=5.0 \text{ mAdc}, V_{GS}=0)$	2N3970 2N3971 2N3972	V _{DS(on)}	17 <u></u> 01-01	1.0 1.5 2.0	Vdc
Static Drain-Source On Resistance (I _D = 1.0 mAdc, V _{GS} = 0)	2N3970 2N3971 2N3972	rDS(on)	20F283Y	30 60 100	Ohms
SMALL-SIGNAL CHARACTERISTICS 60082/45		13114	1 = 1 () =	26) 4	
Drain-Source "ON" Resistance (V _{GS} = 0, I _D = 0, f = 1.0 kHz)	2N3970 2N3971 2N3972	rds(on)	<u>-</u> úi - <u>-</u>	30 60 100	Ohms
Input Capacitance (V _{DS} = 20 Vdc, V _{GS} = 0, f = 1.0 MHz)		C _{iss}	<u> </u>	25	pF .
Reverse Transfer Capacitance $(V_{DS} = 0, V_{GS} = -12 \text{ Vdc}, f = 1.0 \text{ M})$	ЛHz)	C _{rss}	+0.	6.0	pF
SWITCHING CHARACTERISTICS					
Turn-On Delay Time	2N3970 2N3971 2N3972	td(on)		10 15 40	ns
Rise Time	2N3970 2N3971 2N3972	t _r Handos and a Handos and a	lv! = m	10 15 40	ns
Turn-Off Time	2N3970 2N3971 2N3972	^t off		30 60 100	ns

(1) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 3.0%.

2N4091 2N4092 2N4093

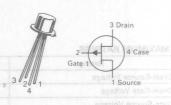
JAN, JTX AVAILABLE CASE 22-03, STYLE 3 TO-18 (TO-206AA)

MAXIMUM RATINGS

The Delivery of the Control of the C			
Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	- 25	Vdc
Drain-Gate Voltage	VDG	- 25	Vdc
Reverse Gate-Source Voltage	VGSR	25	Vdc
Forward Gate Current	IGF	arra 10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300	mW/°C
Storage Temperature Range	T _{stg}	-65 to +200	°C



CASE 20-03, STYLE 5 TO-72 (TO-206AF)



JFET SWITCHING

P-CHANNEL — DEPLETION

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

THE XEAT THEN CH	aracteristic		Symbol	Min	Max	1.2 nAdc 1.2 nAdc 1.2 nAdc 1.2 nAdc 1.0 μAdc 1.0 μAdc 1.0 νdc 9.5 5.5 mAdc 0 mAdc 0 mAdc 0 mAdc 0 mAdc
OFF CHARACTERISTICS						
Gate-Source Breakdown Voltage (I _G = 1.0 µAdc, V _{DS} = 0)	SSD(AS)V		V(BR)GSS	25	Ade, Vps =	
Drain Reverse Current $(V_{DG} = -15 \text{ Vdc}, I_S = 0)$ $(V_{DG} = -15 \text{ Vdc}, I_S = 0, T_A = 150)$	0.C) 40189A		IDGO			nAdc
Drain Cutoff Current $(V_{DS} = -10 \text{ Vdc}, V_{GS} = 10 \text{ Vdc})$ $(V_{DS} = -10 \text{ Vdc}, V_{GS} = 6.0 \text{ Vdc})$		2N3993, 2N3993A 2N3994	ID(off)	100%/1-0	1.2	
$(V_{DS} = -10 \text{ Vdc}, V_{GS} = 10 \text{ Vdc}, T_{CS} = -10 \text{ Vdc}$		2N3993, 2N3993A 2N3994		=	1.0	μAdc
Gate Source Voltage $(V_{DS} = -10 \text{ Vdc}, I_{D} = -1.0 \mu \text{Adc})$	090)	2N3993, 2N3993A 2N3994	VGS	4.0 1.0 A	9.5	g = pgv
ON CHARACTERISTICS					Current	thanuO-mis
Zero-Gate-Voltage Drain Current(1) (V _{DS} = -10 Vdc, V _{GS} = 0)		2N3993, 2N3993A 2N3994	IDSS	10 2.0	Vdc, Vgg = 1 Vdc, Vgg = 1 Vdc, Vgg = 1 Vdc	
SMALL-SIGNAL CHARACTERISTICS		21/4092	= 150°C)	AT JobV 0.8	= ggV ,sbV (E = 20V
Drain-Source "ON" Resistance $(V_{GS} = 0, I_D = 0, f = 1.0 \text{ kHz})$	Nana(2N3993, 2N3993A 2N3994	rds(on)	AT ObV 0.8	150 300	
Forward Transfer Admittance(1) $(V_{DS} = -10 \text{ Vdc}, V_{GS} = 0, f = 1.0)$	kHz)	2N3993 2N3993A	Yfs	6.0 7.0	12	
		2N3994		4.0	agast 10-nO	
Input Capacitance $(V_{DS} = -10 \text{ Vdc}, V_{GS} = 0, f = 1.0)$	MHz)	2N3993, 2N3994 2N3993A	C _{iss}	(6) — (0)	25V 56Am 25 16 5Am 12	DA pF
Reverse Transfer Capacitance (VDS = 0, VGS = 10 Vdc, f = 1.0 M	ЛНz)	2N3993 2N3993A	C _{rss}	-10	4.5 3.0	
$(V_{DS} = 0, V_{GS} = 6.0 \text{ Vdc, f} = 1.0)$	MHz)	2N3994		-	5.0	

(1) Pulse Test: Pulse Width = 100 ms, Duty Cycle ≤ 10%.

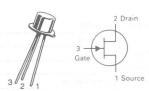
2N3993,A 2N3994

MAXIMUM RATINGS

Rating	Symbol	Value	Unit	
Drain-Source Voltage	V _{DS}	40	Vdc	
Drain-Gate Voltage	VDG	40	Vdc	
Gate-Source Voltage	VGS	40	Vdc	
Gate Current	IG _	10 10	mAdc	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.8 Was 10	Watts mW/°C	
Junction Temperature Range	TJ	-65 to +175	°C	
Storage Temperature Range	T _{stg}	-65 to +175	Ol CoC	

2N4091 2N4092 2N4093

JAN, JTX AVAILABLE CASE 22-03, STYLE 3 TO-18 (TO-206AA)



JFET SWITCHING

N-CHANNEL - DEPLETION

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					c - v - v	2
Gate-Source Breakdown Voltage (IG = 1.0 μ Adc, VDS = 0)	V(anjess		V(BR)GSS	40	i,	Vdc
Drain-Gate Breakdown Voltage (I _D = 1.0 μAdc, I _S = 0) ,			V(BR)DGO	40		Vdc
Gate Source Cutoff Voltage (V _{DS} = 20 Vdc, I _D = 1.0 nAdc)	(No)G [†]	2N4091 2N4092 2N4093	VGS(off)	5.0 2.0 1.0	10 7.0 5.0	Vdc
Source Reverse Current (VSG = 20 Vdc, ID = 0)		APBELIAS DE SELSESA ZNIESSA	Isgo	2 (15 0)	0.2	nAdc
Drain Reverse Current (V _{DG} = 20 Vdc, I _S = 0) (V _{DG} = 20 Vdc, I _D = 0, T _A = 150°C	Ves	AEGREUZ REGEGAL ZGEDRA	IDGO	100A =	0.2 0.4	nAdc μAdc
Drain-Cutoff Current (VDS = 20 Vdc, VGS = 12 Vdc) (VDS = 20 Vdc, VGS = 8.0 Vdc) (VDS = 20 Vdc, VGS = 6.0 Vdc) (VDS = 20 Vdc, VGS = 12 Vdc, TA = 0.0 Vdc) (VDS = 20 Vdc, VGS = 8.0 Vdc, TA = 0.0 V		2N4091 2N4092 2N4093 2N4091 2N4092	ID(off)	('Bneun _() UST—NA	0.2 0.2 0.2 0.4 0.4	nAdc μAdc
(V _{DS} = 20 Vdc, V _{GS} = 6.0 Vdc, T _A		2N4093		_	0.4	

ON CHARACTERISTICS

OH OHAHAOTEHIOTIOO					
Zero-Gate-Voltage Drain Current*	ZN3394	IDSS*			mAdc
$(V_{DS} = 20 \text{ Vdc}, V_{GS} = 0)$	2N4091		30		
12 0.8	2N4092	Tylen I	15		
	2N4093		8.0	_	
Drain-Source On-Voltage	2-88EVS	V _{DS(on)}			Vdc
$(I_D = 6.6 \text{ mAdc}, V_{GS} = 0)$	2N4091	50(011)		0.2	
$(I_D = 4.0 \text{ mAdc}, V_{GS} = 0)$	2N4092		_	0.2	
$(I_D = 2.5 \text{ mAdc}, V_{GS} = 0)$	1000 Mg 2N4093	(1991)	_	0.2	
Static Drain-Source On Resistance	Assessic	rDS(on)			Ohms
$(I_D = 1.0 \text{ mAdc}, V_{GS} = 0)$	2N4091		_	30	
8.4	2N4092		-	50	
	2N4093		_	80	

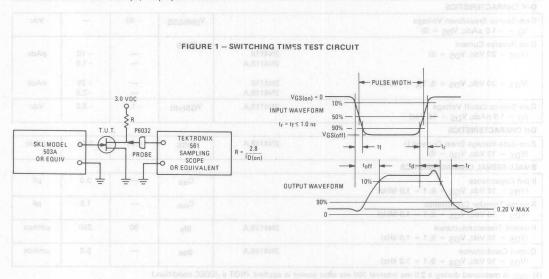
6

2N4091, 2N4092, 2N4093

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

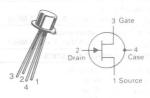
Characteristi	С		Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS						
Drain-Source "ON" Resistance $(V_{GS} = 0, I_D = 0, f = 1.0 \text{ kHz})$		2N4091 2N4092 2N4093	^r ds(on)	Ξ	30 50 80	Ohms
Input Capacitance (V _{DS} = 20 Vdc, V _{GS} = 0, f = 1.0 MHz)			C _{iss}	-	16	pF
Reverse Transfer Capacitance (V _{DS} = 0, V _{GS} = 20 Vdc, f = 1.0 MHz)			C _{rss}	-	5.0	pF MUMBKAN
SWITCHING CHARACTERISTICS						
Delay Time (See Figure 1) (ID(on) = 6.6 mAdc) (ID(on) = 4.0 mAdc) (ID(on) = 2.5 mAdc)	abV abV abAm	2N4091 2N4092 2N4093	20V t _d	=	15 15 20	e Current
Rise Time (See Figure 1) $ \begin{pmatrix} ID_{\{On\}} = 6.6 \text{ mAdc} \end{pmatrix} $ $ \begin{pmatrix} ID_{\{On\}} = 4.0 \text{ mAdc} \end{pmatrix} $ $ \begin{pmatrix} ID_{\{On\}} = 2.5 \text{ mAdc} \end{pmatrix} $	O'AWan 20	2N4091 2N4092 2N4093	t _r	- 1		ns ods erand ragmaT bas mani 'arm
Turn-Off Time (See Figure 1) (VGS(off) = 12 Vdc) (VGS(off) = 8.0 Vdc) (VGS(off) = 6.0 Vdc)		2N4091 2N4092 2N4093	greT toff	1801 <u>1</u> 108	40 60 80	BCTHICAL

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 3.0%.



2N4118,A

CASE 20-03, STYLE 1 TO-72 (TO-206AF)



JFET AMPLIFIER

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

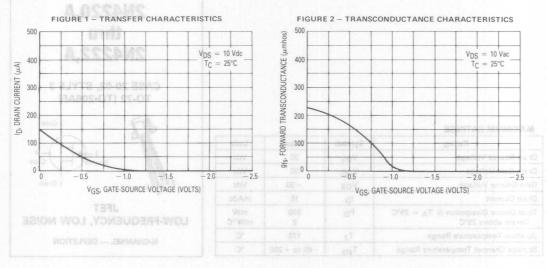
Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	-40	Vdc
Drain-Gate Voltage	VDG	180AI4540	Vdc
Gate Current	IG	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 2.0	mW mW/°C
Lead Temperature (1/16" from case for 10 s)	TL	\$804-255 \$80445	°C
Storage Temperature Range	Hof Tstg	-65 to +175	°C

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Symbol	Min	Max	Unit
V _(BR) GSS	-40	_	Vdc
	_	- 10 - 1.0	pAdc
	_	- 25 - 2.5	nAdc
VGS(off)	-1.0	-3.0	Vdc
r1	role P		
IDSS	0.08	0.24	mAdd
TKE JAVILJBE BR			
C _{iss}	4-5	3.0	pF
C _{rss}	_	1.5	pF
9fs	80	250	μmho
gos	_	5.0	μmho
200	V(BR)GSS A VGS(off) Ciss Crss A GSS Crss GSS Crss	V(BR)GSS -40 V(BR)GSS -40 A	V(BR)GSS -40 - V(BR)GSS -40 - A - 10 - 1.0 - 25 - 2.5 A VGS(off) -1.0 -3.0 Ciss - 3.0 Crss - 1.5 A 9fs 80 250

⁽¹⁾ IDSS is measured during a 2.0 ms interval 100 ms after power is applied. (NOT a JEDEC condition.)



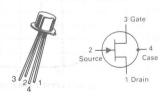


LECTRICAL CHARACTERISTICS ($f_A=28^{\circ}C$)				
	2N4220,A 2N4221,A 2N4222,A			Vdc
ro-Cata-Voltage Brain Current* VDS = 15 Vds, VGS = 9)				
	2N4220,A 2N4221,A 2N4222,A			
ideur Admittance Common Source (Vos = 15 Vdc, Vos = 0, f = 1.0 kHz)				Empos
put Capacitands (VDS = 16 Vdc, VGS = 0, f = 1.0 MHz)				
iverse Transfer Capacitance (VDS - 15 Vdc VGS - 0, f = 1,0 MHz)				

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

2N4220,A thru 2N4222,A

CASE 20-03, STYLE 3 TO-72 (TO-206AF)



JFET LOW-FREQUENCY, LOW NOISE

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

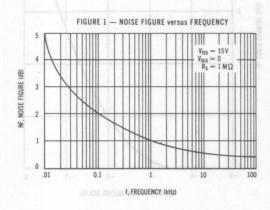
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	30	Vdc
Drain-Gate Voltage	VDG	30	Vdc
Gate-Source Voltage	VGS	-30	Vdc
Drain Current	ID	15	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 2	mW mW/°C
Junction Temperature Range	TJ	175	°C
Storage Channel Temperature Range	T _{sta}	-65 to +200	°C

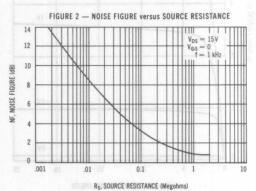
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

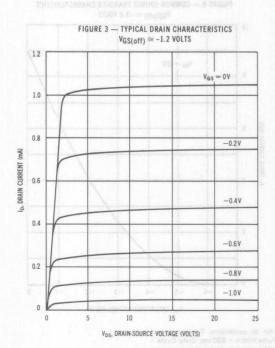
Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Gate-Source Breakdown Voltage ($I_G = -10 \mu Adc, V_{DS} = 0$)		V(BR)GSS	- 30	_	_	Vdc
Gate Reverse Current $(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0, T_A = 150^{\circ}\text{C})$		IGSS	_	_	- 0.1 - 100	nAdc
Gate Source Cutoff Voltage (ID = 0.1 nAdc, VDS = 15 Vdc)	2N4220,A 2N4221,A 2N4222,A	VGS(off)	_	_	-4 -6 -8	Vdc
Gate Source Voltage ($I_D = 50 \mu Adc, V_{DS} = 15 Vdc$) ($I_D = 200 \mu Adc, V_{DS} = 15 Vdc$) ($I_D = 500 \mu Adc, V_{DS} = 15 Vdc$)	2N4220,A 2N4221,A 2N4222,A	VGS	- 0.5 - 1.0 - 2.0		-2.5 -5.0 -6.0	Vdc
ON CHARACTERISTICS						
Zero-Gate-Voltage Drain Current* $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0)$	2N4220,A 2N4221,A 2N4222,A	IDSS	0.5 2.0 5.0	=	3.0 6.0 15	mAdc
Static Drain-Source On Resistance $(V_{DS} = 0, V_{GS} = 0)$	2N4220,A 2N4221,A 2N4222,A	rDS(on)	_	500 400 300	=	Ohms
SMALL-SIGNAL CHARACTERISTICS						
Forward Transfer Admittance Common Source* ($V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz}$)	2N4220,A 2N4221,A 2N4222,A	Yfs	1000 2000 2500	=	4000 5000 6000	μmhos
Output Admittance Common Source ($V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz}$)	2N4220,A 2N4221,A 2N4222,A	lyosl		=	10 20 40	μmhos
Input Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)		C _{iss}	_	4.5	6.0	pF
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)		C _{rss}	_	1.2	2.0	pF
Common-Source Output Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 30 MHz)		C _{osp}	_	1.5	_	pF

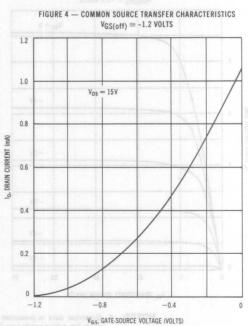
^{*}Pulse Test: Pulse Width = 630 ms, Duty Cycle = 10%.

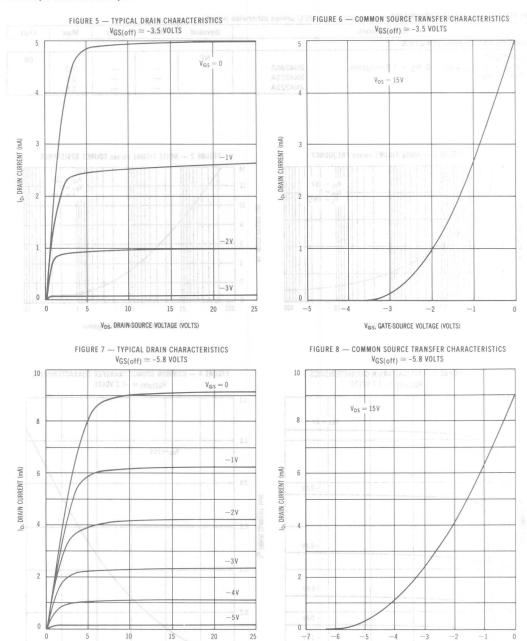
Characteristic		Symbol	Min	Тур	Max	Unit
FUNCTIONAL CHARACTERISTICS	Time and the second	and many property (School)				14
Noise Figure		NF				dB
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, R_{S} = 1.0 \text{ megohm},$	2N4220A	0 201	_	_	2.5	
f = 100 Hz)	2N4221A		_	-	2.5	
	2N4222A		_	-	2.5	d a











NOTES: 1. Graphical data is presented for dc conditions. Tabular data is given for pulsed conditions (Pulse Width = 630 ms, Duty Cycle = 10%). Under dc conditions, self heating in higher IDSS units reduces IDSS (See Figure 10).

V_{DS}, DRAIN-SOURCE VOLTAGE (VOLTS)

 Figures 8, 9, 10: Data taken in a standard printed circuit with a TO-18 type socket mounting and 1/4" lead length.

VGS, GATE-SOURCE VOLTAGE (VOLTS)

2NA351 CASE 20-03, STYLE TO-72 (TO-206AF)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	50	Vdc
Drain-Gate Voltage	V _{DG}	50	Vdc
Gate-Source Voltage	VGS	50	Vdc
Reverse Gate-Source Voltage	VGSR	50	Vdc
Gate Current	IG	50 E	a.a mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 2.0	mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +200	°C

2N4338 2N4339 2N4340 2N4341

CASE 22-03, STYLE 3 TO-18 (TO-206AA)



JFET SOME NOISE

N-CHANNEL — DEPLETION

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) and a stellar Dras = ATI 20173/9310 ARABO JADIRTO-133

ziet/ xeM siM C	haracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Gate-Source Breakdown Voltage $(I_G = -1.0 \mu A)$	XSO(RB)V		V(BR)GSS	50	a Bre <u>siu</u> down A, Ves = 0	
Gate Reverse Current (VGS = -30 V)	ssol		IGSS	Curro <u>as</u>) "T _A = 28°t	nier0.10110	
Gate Source Cutoff Voltage (VDS = 15 V, ID = 0.1 μ A)	8891	2N4338 2N4339	VGS(off)	- 0.3 - 0.6	20V-1.8	Vdc
		2N4340 2N4341		-1.0 -2.0	-3.0 -6.0	MAHO NO
ON CHARACTERISTICS	WITHOUT !			(Au	01 = 01 V	W = priVi
Zero-Gate-Voltage Drain Current (V _{DS} = 15 V)	(ne)2QV	2N4338 2N4339	IDSS*	0.2	0.6 1.5	mA
		2N4340 2N4341		1.2 3.0	3.6 9.0	NGS = 1
SMALL-SIGNAL CHARACTERISTICS				TERISTICS.	NAL CHARAC	SMYTT-SHE
Forward Transfer Admittance (VDS = 15 V, f = 1.0 kHz)	etvi	2N4338	Yfs *	600 Am	1800	μmhos
		2N4339 2N4340 2N4341		800 1300 2000	2400 3000 4000	Vivi Capac
Output Admittance	5813		y _{os}	(sini linia)	Ves = 0,f	μmhos
(V _{DS} = 15 V, f = 1.0 kHz)		2N4338 2N4339 2N4340		100 (Hz)	5.0 15 30	WD(SUB)
amrio 006	/daton	2N4341		_	60	sin-Source
Input Capacitance (VDS = 15 V, f = 1.0 MHz)			C _{iss}	SOLLEN (250) O')	6.0	pF
Reverse Transfer Capacitance (VDS = 15 V, f = 1.0 MHz)	161	Vdz,	Or = pgV abAm 0.3	S = 01	2.0	pF
FUNCTIONAL CHARACTERISTICS	out.		(obv 07	Yes	(Yo. 2)	leG IfO-mi
Noise Figure (VDS = 15 Volts, f = 1.0 kHz, RG =	1	1090MNYOJOU A	NF			andB

^{*}Pulse Test: Pulse Width ≤ 630 ms, Duty Cycle ≤ 10%.

MAXIMUM RATINGS 38 38 AO

Rating RT-OT	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG}	30	Vdc
Gate-Source Voltage*	VGS	30	Vdc
Drain Current	ID	30	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.7	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	800 Am 4.56	mW mW/°C
Junction Temperature Range	OJ TJ	Wm 175)0E °C
Storage Temperature Range	T _{stg}	-65 to +175	°C

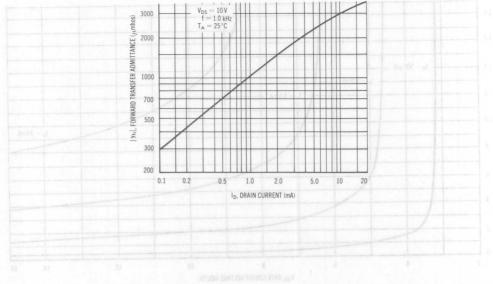
^{*}Transient potentials of ±75 Volt will not cause gate-oxide failure.

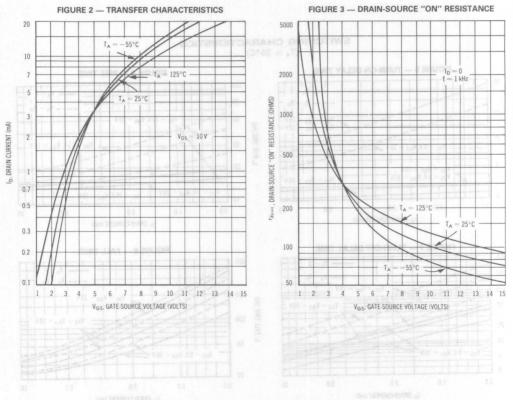
CASE 20-03, STYLE 2 TO-72 (TO-206AF) 3 Drain 4 Case MOSFET SWITCHING N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) hards about 0.35 and 10.00 also

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					경기 시기	7 17.
Drain-Source Breakdown V (I _D = 10 μA, V _{GS} = 0)	oltage BBB(RB)V		V(BR)DSX	25	- F	Vdc
Zero-Gate-Voltage Drain Cu (V _{DS} = 10 V, V _{GS} = 0)			IDSS	=	10 10	nAdc μAdc
Gate Reverse Current (VGS = ±15 Vdc, VDS =	0.3 - 0.0		IGSS	= (4	± 10	pAdc
ON CHARACTERISTICS	0.1 -	ONLING				
Gate Threshold Voltage (V _{DS} = 10 V, I _D = 10 μA	λ)	100,0012	V _{GS(Th)}	1.0	5	Vdc
Drain-Source On-Voltage (ID = 2.0 mA, VGS = 10	*880 ¹ (V	274338	V _{DS(on)}	<u> In</u> 3410	1.0	V
On-State Drain Current (VGS = 10 V, VDS = 10	V) 0.8	2N4340 2N4341	lD(on)	3.0	_	mAdc
SMALL-SIGNAL CHARACT	ERISTICS			2011 JIRLY	SUNALIS	
Forward Transfer Admittan (V _{DS} = 10 V, I _D = 2.0 m		8884/45	Yfs	1000	61 - L	μmho
Input Capacitance (VDS = 10 V, VGS = 0,	008 f = 140 kHz)	2N4239 2N4340	C _{iss}	-	5.0	pF
Reverse Transfer Capacitan (V _{DS} = 0, V _{GS} = 0, f =		165,475	C _{rss}		1.3	pF
Drain-Substrate Capacitano (VD(SUB) = 10 V, f = 14		BECAMS BERAMS MAFAMS	C _{d(sub)}	-	5.0	pF
Drain-Source Resistance (VGS = 10 V, I _D = 0, f =	= 1.0 kHz)	2N4341	rds(on	_	300	ohms
SWITCHING CHARACTERIS	STICS			1-11	2 19 1	
Turn-On Delay (Fig. 5)	Cras —		t _{d1}	-101	45	ns
Rise Time (Fig. 6)	I _D = 2.0 mAdc, V _{DS} V _{GS} = 10 Vdc)	= 10 Vdc,	t _r		65	ns
Turn-Off Delay (Fig. 7)	(See Figure 9; Times	Circuit Determined)	t _{d2}	80912073	60	ns
Fall Time (Fig. 8)	- 334		tf		100	ns



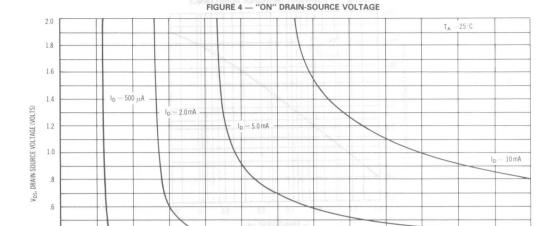




MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

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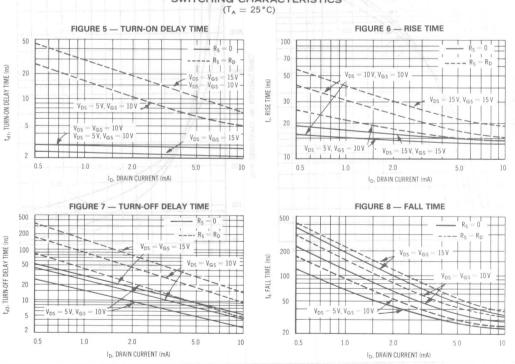




V_{GS}, GATE-SOURCE VOLTAGE (VOLTS)

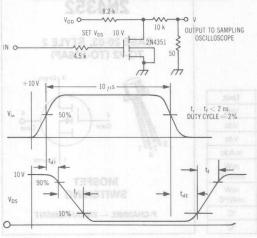
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MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 9 — SWITCHING CIRCUIT and WAVEFORMS



The switching characteristics shown above were measured in a test circuit similar to Figure 10. At the beginning of the switching interval, the gate voltage is at ground and the gate-source

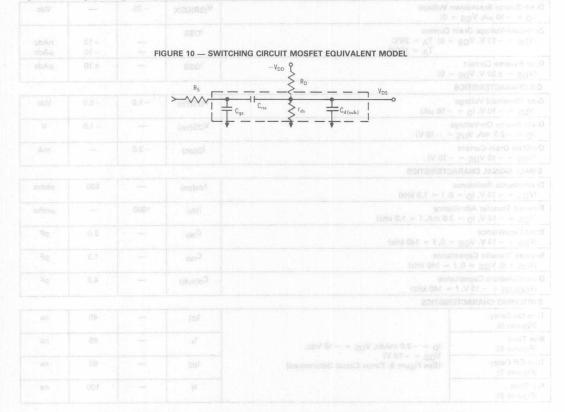
capacitance ($C_{gs} = C_{iss} - C_{rss}$) has no charge. The drain voltage is at V_{DD}, and thus the feedback capacitance (C_{rss}) is charged to V_{DD}. Similarly, the drain-substrate capacitance ($C_{d(sub)}$) is charged to V_{DD} since the substrate and source are connected to ground.

During the turn-on interval, C_{gs} is charged to V_{GS} (the input voltage) through R_S (generator impedance). C_{FS} must be discharged to $V_{GS} - V_{D(on)}$ through R_S and the parallel combination of the load resistor (R_D) and the channel resistance (r_{dS}). In addition, $C_{d(sub)}$ is discharged to a low value ($V_{D(on)}$) through R_D in parallel with r_{dS} . During turn-off this charge flow is reversed.

Predicting turn-on time proves to be somewhat difficult since the channel resistance (r_{ds}) is a function of the gate-source voltage (VGS). As C_{gs} becomes charged, VGS is approaching V_{in} and r_{ds} decreases (see Figure 4) and since C_{rss} and $C_{d(sub)}$ are charged through r_{ds} turn-on time is quite non-linear.

If the charging time of C_{gs} is short compared to that of C_{rss} and $C_{d(sub)}$, then r_{ds} (which is in parallel with R_D) will be low compared to R_D during the switching interval and will largely determine the turn-on time. On the other hand, during turn-off r_{ds} will be almost an open circuit requiring C_{rss} and $C_{d(sub)}$ to be charged through R_D and resulting in a turn-off time that is long compared to the turn-on time. This is especially noticeable for the curves where $R_S = 0$ and C_{gs} is charged through the pulse generator impedance only.

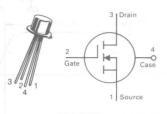
The switching curves shown with $R_S=R_D$ simulate the switching behavior of cascaded stages where the driving source impedance is normally the same as the load impedance. The set of curves with $R_S=0$ simulates a low source impedance drive such as might occur in complementary logic circuits.



MAXIMUM RATINGS

well agreed and its Rating mid and riting is	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage to notional a el labil so	VDG	to edt 30	Vdc
Gate-Source Voltage	VGS	±30	Vdc
Drain Current	and Date	gasrio 30	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	charging the i(su)), then to	300 0 box 1.7	mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD and	800 4.56	mW mW/°C
Junction Temperature Range	ngoot Joogn	no ed 175	°C
Storage Temperature Range	T _{stg}	- 65 to + 175	°C

CASE 20-03, STYLE 2 TO-72 (TO-206AF)



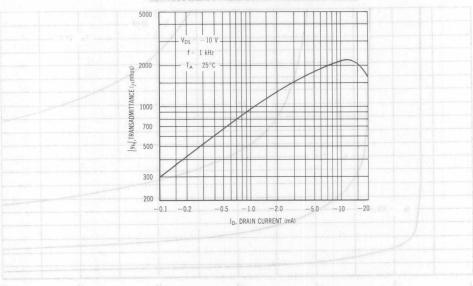
MOSFET SWITCHING

P-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

s me load impedance. Fire se	Characteristic	antared in	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	such as might occur in compleme	earthea	ag and the gas	nty hi ta nga	Jan 19 page	tion to
Drain-Source Breakdown Vo $(I_D = -10 \mu A, V_{GS} = 0)$			V _{(BR)DSX}	- 25	_	Vdc
Zero-Gate-Voltage Drain Cur $(V_{DS} = -10 \text{ V}, V_{GS} = 0)$		CHRISC CREUITMEN	IDSS	- -	- 10 - 10	nAdc μAdc
Gate Reverse Current $(V_{GS} = \pm 30 \text{ V}, V_{DS} = 0)$			IGSS	_	± 10	pAdc
ON CHARACTERISTICS	was and the same	and the same and	- 18			
Gate Threshold Voltage (VDS = -10 V, ID = -10) μΑ)		VGS(Th)	- 1.0	-5.0	Vdc
Drain-Source On-Voltage (ID = -2.0 mA, VGS = -	- 10 V)	-	V _{DS(on)}	_	-1.0	V
On-State Drain Current (VGS = -10 VDS = -10	(V)		I _{D(on)}	-3.0	-	mA
SMALL-SIGNAL CHARACTE	ERISTICS					
Drain-Source Resistance $(V_{GS} = -10 \text{ V}, I_D = 0, f = 1.0 \text{ kHz})$		^r ds(on)	_	600	ohms	
Forward Transfer Admittant ($V_{DS} = -10 \text{ V}, I_D = 2.0 \text{ m}$			Yfs	1000	-	μmho
Input Capacitance (V _{DS} = -10 V, V _{GS} = 0,	, f = 140 kHz)		C _{iss}	_	5.0	pF
Reverse Transfer Capacitano (V _{DS} = 0, V _{GS} = 0, f =			C _{rss}		1.3	pF
Drain-Substrate Capacitance (VD(SUB) = -10 V, f = 1			C _{d(sub)}	-	4.0	pF
SWITCHING CHARACTERIS	TICS					
Turn-On Delay (Figures 5)			^t d1	-	45	ns
	$I_D = -2.0 \text{ mAdc}, V_{DS} = -10 \text{ Vdc}$		t _r	-	65	ns
	$V_{GS} = -10 \text{ V}$ (See Figure 9, Times Circuit Determ	ined)	t _{d2}	_	60	ns
Fall Time (Figures 8)			tf	_	100	ns

FIGURE 1 — FOWARD TRANSFER ADMITTANCE



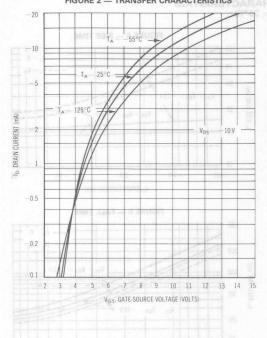


FIGURE 2 — TRANSFER CHARACTERISTICS FIGURE 3 — DRAIN-SOURCE "ON" RESISTANCE

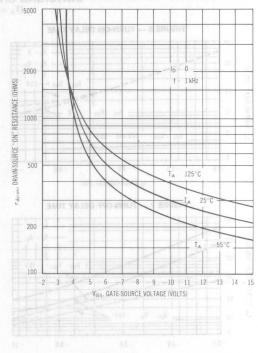
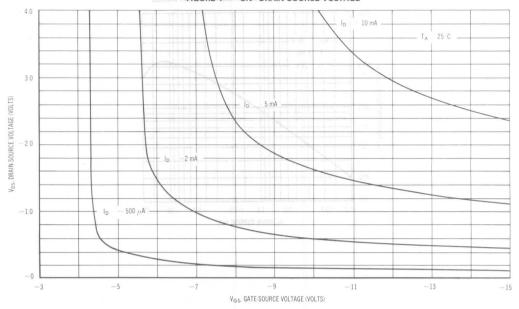


FIGURE 4 — "ON" DRAIN-SOURCE VOLTAGE



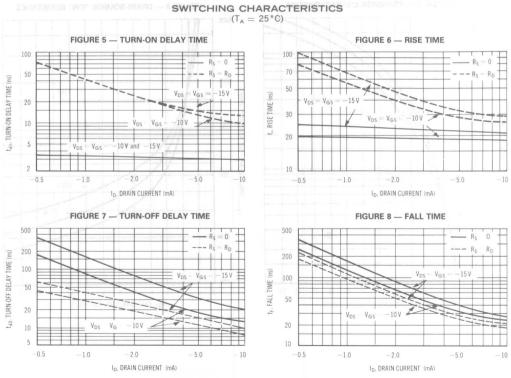
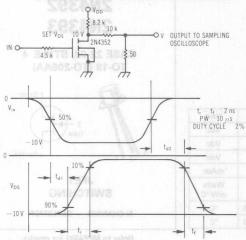


FIGURE 9 — SWITCHING CIRCUIT and WAVEFORMS



The switching characteristics shown above were measured in a test circuit similar to Figure 10. At the beginning of the switching interval, the gate voltage is at ground and the gate-source capacitance (Cgs = Ciss — Crss) has no charge. The drain voltage is at VDD, and

thus the feedback capacitance (C_{rss}) is charged to V_{DD} . Similarly, the drain-substrate capacitance ($C_{d(sub)}$) is charged to V_{DD} since the substrate and source are connected to ground.

During the turn-on interval, C_{gs} is charged to V_{GS} (the input voltage) through R_S (generator impedance) (Figure 11). C_{rss} must be discharged to $V_{GS} - V_{D}(on)$ through R_S and the parallel combination of the load resistor (R_D) and the channel resistance (r_{ds}) is a function of the gate-source voltage (V_{GS}). As C_{gs} becomes charged V_{GS} is approaching V_{in} and r_{ds} decreases (see Figure 4) and since C_{rss} and $C_{d}(sub)$ are charged through r_{ds} , turn-on time is quite non-linear.

If the charging time of C_{gs} is short compared to that of C_{rss} and $C_{d(sub)}$, then r_{ds} (which is in parallel with R_D) will be low compared to R_D during the switching interval and will largely determine the turn-on time. On the other hand, during turn-off r_{ds} will be almost an open circuit requiring C_{rss} and $C_{d(sub)}$ to be charged through R_D and resulting in a turn-off time that is long compared to the turn-on time. This is especially noticeable for the curves where $R_S = 0$ and C_{gs} is charged through the pulse generator impedance only.

The switching curves shown with $R_S = R_D$ simulate the switching behavior of cascaded stages where the driving source impedance is normally the same as the load impedance. The set of curves with $R_S = 0$ simulates a low source impedance drive such as might occur in complementary logic circuits.

FIGURE 10 — SWITCHING CIRCUIT with MOSFET EQUIVALENT

		(min Sourse On-Voltage Ilig = 12 n.kde, Vgs = 0) Ilig = 6.0 mAde, Vgs = 0) Ilig = 3.0 mAde, Vgs = 0)

2N4392 2N4393

CASE 22-03, STYLE 4 TO-18 (TO-206AA)





JFET SWITCHING

N-CHANNEL — DEPLETION

Refer to MPF4391 for graphs.

MAXIMUM RATINGS

Deprend one Rating of the ago so	Symbol	Value	Unit
Drain-Source Voltage	VDS	40	Vdc
Drain-Gate Voltage	V _{DG}	40	Vdc
Gate-Source Voltage with gift of beingm	VGS	40	Vdc
Forward Gate Current of entires 195 yield	IGF	50	*mAdc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8	Watts mW/°C
Operating Junction Temperature Range	TJ	-65 to +175	°C
Storage Temperature Range	T _{stg}	-65 to +175	°C

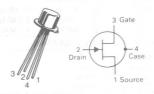
*ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	al another	Symbol	Min	Max	Unit
OFF CHARACTERISTICS with somebagini soluce will a seta	2015 = 3k3	i eanathreaso u	511 cur - 516 s	9515	
Gate-Source Breakdown Voltage 113 Jipol visinsimsigmos it ($I_G = 1.0 \mu Adc, V_{DS} = 0$)		V(BR)GSS	40	A	Vdc
Gate Reverse Current $(V_{GS} = 20 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = 20 \text{ Vdc}, V_{DS} = 0, T_{A} = 150^{\circ}\text{C})$		IGSS	_	0.1 0.2	nAdc μAdc
Gate Source Voltage (V _{DS} = 20 Vdc, I _D = 1.0 nAdc)	2N4391 2N4392 2N4393	VGS	4.0 2.0 0.5	10 5.0 3.0	Vdc
Gate-Source Forward Voltage (IG = 1.0 mAdc, VDS = 0)	-	V _{GS(f)}	_	1.0	Vdc
Drain-Cutoff Current (VDS = 20 Vdc, VGS = 12 Vdc) (VDS = 20 Vdc, VGS = 7.0 Vdc) (VDS = 20 Vdc, VGS = 5.0 Vdc) (VDS = 20 Vdc, VGS = 5.0 Vdc, TA = 150°C) (VDS = 20 Vdc, VGS = 7.0 Vdc, TA = 150°C) (VDS = 20 Vdc, VGS = 5.0 Vdc, TA = 150°C)	2N4391 2N4392 2N4393 2N4391 2N4392 2N4393	ID(off)		0.1 0.1 0.1 0.2 0.2	nAdc μAdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(1) (V _{DS} = 20 Vdc, V _{GS} = 0)	2N4391 2N4392 2N4393	IDSS	50 25 5.0	150 75 30	mAdc
Drain-Source On-Voltage $(I_D = 12 \text{ mAdc}, V_{GS} = 0)$ $(I_D = 6.0 \text{ mAdc}, V_{GS} = 0)$ $(I_D = 3.0 \text{ mAdc}, V_{GS} = 0)$	2N4391 2N4392 2N4393	V _{DS(on)}	=	0.4 0.4 0.4	Vdc
Static Drain-Source On Resistance $(I_D=1.0 \text{ mAdc}, V_{\hbox{\footnotesize GS}}=0)$	2N4391 2N4392 2N4393	rDS(on)	Ξ	30 60 100	Ohms
SMALL-SIGNAL CHARACTERISTICS					
Drain-Source "ON" Resistance (VGS = 0, I _D = 0, f = 1.0 kHz)	2N4391 2N4392 2N4393	^r ds(on)	=	30 60 100	Ohms

Characteristic			Symbol	Min	Max	Unit				
	citance 20 Vdc, V _{GS} =						C _{iss}	-	14	pF
$(V_{DS} = 0)$ $(V_{DS} = 0)$	ansfer Capacit. 0, V _{GS} = 12 V 0, V _{GS} = 7.0 V 0, V _{GS} = 5.0 V	dc, f = 1. $dc, f = 1$.0 MHz)			2N4391 2N4392 2N4393	C _{rss}	Ξ	3.5 3.5 3.5	pF
SWITCHIN	G CHARACTE	RISTICS						2	IM RATING	MINECAN
Rise Time (I _{D(on)} =	= 12 mAdc)			Held		2N4391	t _r	9	5.0	ns
	= 6.0 mAdc) = 3.0 mAdc)	. 10	gar.	Vdc	30	2N4392 2N4393	1V 814	MS -	5.0 5.0	Drain-Sou Drain-Gat
Fall Time (VGS(off) = 12 Vdc) (VGS(off) = 7.0 Vdc) (VGS(off) = 5.0 Vdc)				2N4391	t _f ASTA	20%	age15 V 63	ns wood-waar		
		mAde	01	2N4392 2N4393		_	20 30	rmi Diarob		
Turn-On Time (ID(on) = 12 mAdc)				2N4391	ton	(G Tg = 2)	15	ns		
(I _D (on) = (I _D (on) =	= 6.0 mAdc) = 3.0 mAdc)	LXTL	TAL	D ^e	o + 175	2N4392 2N4393	I.I.T	n oti onel	egeno15 brie egm15 mun	
) = 12 Vdc)					2N4391	Hoff	CTE M ETIC		ns
	$y_1 = 7.0 \text{ Vdc}$ $y_2 = 5.0 \text{ Vdc}$					2N4392 2N4393	olitainatus runi Ciransaction		35 50	
	st: Pulse Width to JEDEC Regi		Duty Cycle ≤ 1 a.	.0%. 11 14 14 14 14 14 14 14 14 14 14 14 14 1					e Breskdown 0 "Ado. Vpg	

2N4416,A

CASE 20-03, STYLE 1 TO-72 (TO-206AF)



JFET VHF/UHF AMPLIFIER

N-CHANNEL — DEPLETION

JAN JTX JTXV AVAILABLE

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Drain-Source Voltage		VDS	08 20439	Vdc
Drain-Gate Voltage	2N4416 2N4416A	VDG	30 35	Vdc
Gate-Source Voltage		VGS	30	Vdc
Gate Current		I _G	10	mAdc
Total Device Dissipation Derate above 25°C	@ T _A = 25°C	PD	300 1.71	mW mW/°C
Operating and Storage J Temperature Range	unction	TJ, T _{stg}	-65 to +175	°C

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		M. Carrier, State C	Burtlet I P		1
Gate-Source Breakdown Voltage (IG = 1.0 μ Adc, VDS = 0)	2N4416 2N4416A	V _(BR) GSS	30 35	=	Vdc
Gate Reverse Current $(V_{GS}=20\ Vdc,V_{DS}=0)$ $(V_{GS}=20\ Vdc,V_{DS}=0,T_{A}=+150^{\circ}C)$		IGSS	_	100 200	pAdc
Gate Source Cutoff Voltage (I _D = 1.0 nAdc, V _{DS} = 15 Vdc)		VGS(off)	_	6.0	Vdc
Gate Source Voltage (I _D = 0.5 mAdc, V _{DS} = 15 Vdc)		VGS	1.0	5.5	Vdc
Gate-Source Forward Voltage (I _G = 1.0 mAdc, V _{DS} = 0)		V _{GS(f)}	-	1.0	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(1) ($V_{DS} = 15 \text{ Vdc}, V_{GS} = 0$)		IDSS	5.0	15	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance(1) $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$		Yfs	4500	7500	μmhos
Real Part of Forward Transfer Admittance ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 400 \text{ MHz}$)		Yfs(real)	4000	_	μmhos
Real Part of Input Admittance $(V_{DS}=15~Vdc, V_{GS}=0, f=100~MHz)$ $(V_{DS}=15~Vdc, V_{GS}=0, f=400~MHz)$		Yis(real)	_	100 1000	μmhos
Output Admittance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$		Yos	_	50	μmhos
Real Part of Output Admittance $(V_{DS}=15\ Vdc,V_{GS}=0,f=100\ MHz)$ $(V_{DS}=15\ Vdc,V_{GS}=0,f=400\ MHz)$		Yos(real)	_	75 100	μmhos
Imaginary Part of Input Admittance ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 100 \text{ MHz}$) ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 400 \text{ MHz}$)		Yis(imag)	_	2500 10,000	μmhos
Imaginary Part of Output Admittance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 100 MHz) (V _{DS} = 15 Vdc, V _{GS} = 0, f = 400 MHz)		Yos(imag)	_	1000 4000	μmhos

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
Input Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0 MHz)	ATJOV 3D Ciss MA	10 304(TD3	4.0	pF
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	C _{rss}	-	0.8	pF
Common Source Output Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	Coss	-	2.0	pF
FUNCTIONAL CHARACTERISTICS		700000	7	9 3 14
Noise Figure (Figures 3 and 4) $ (V_{DS} = 15 \text{ Vdc, I}_D = 5.0 \text{ mAdc, R}_g \approx 1000 \text{ Ohms, f} = 100 \text{ MHz}) $ $ (V_{DS} = 15 \text{ Vdc, I}_D = 5.0 \text{ mAdc, R}_g \approx 1000 \text{ Ohms, f} = 400 \text{ MHz}) $	NF	4	2.0 4.0	dB
Small-Signal Power Gain Common Source (Figure 1) (VDS = 15 Vdc, ID = 5.0 mAdc, f = 100 MHz) (VDS = 15 Vdc, ID = 5.0 mAdc, f = 400 MHz)	G _{ps}	18 10	\$100 KHZ	dB

⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 1.0%.

POWER GAIN

FIGURE 1 - EFFECTS OF DRAIN CURRENT

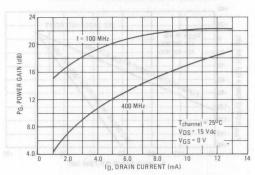
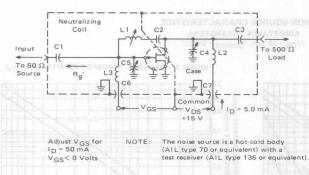


FIGURE 2 - 100 MHz and 400 MHz NEUTRALIZED TEST CIRCUIT

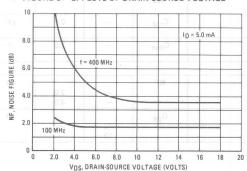


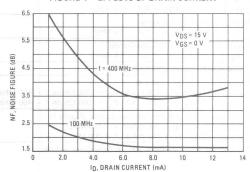
Reference	VALUE					
Designation	100 MHz	400 MHz				
C1	7.0 pF	1.8 pF				
C2	1000 pF	17 pF				
C3	3.0 pF	1.0 pF				
C4	1-12 pF	0.8-8.0 pF				
C5	1-12 pF	0.8-8.0 pF				
C6	0.0015 μF	0.001 μF				
C7	0.0015 μF	0.001 μF				
L1	3.0 µH*	0.2 μΗ**				
L2	0.15 μH*	0.03 μΗ**				
L3	0.14 μΗ*	0.022 µH * *				

- *L1 17 turns, (approx. depends upon circuit layout) AWG #28 enameled copper wire, close wound on 9/32" ceramic coil form. Tuning provided by a powdered iron slug.
 L2 4-1/2 turns, AWG #18 enameled copper wire, 5/16" long, 3/8" I.D. (AIR CORE).
- L3 3-1/2 turns, AWG #18 enameled copper wire, 1/4" long, 3/8" I.D. (AIR CORE).
- **L1 6 turns, (approx. depends upon circuit layout) AWG #24 enameled copper wire, close wound on 7/32" ceramic coil form. Tuning provided by an aluminum slug.
- 1 turn, AWG #16 enameled copper wire, 3/8" I.D. (AIR CORE).
- L3 1/2 turn, AWG #16 enameled copper wire, 1/4" I.D. (AIR CORE).

FIGURE 3 – EFFECTS OF DRAIN-SOURCE VOLTAGE

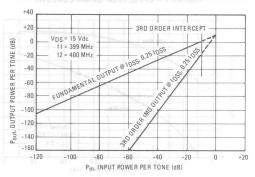
FIGURE 4 - EFFECTS OF DRAIN CURRENT





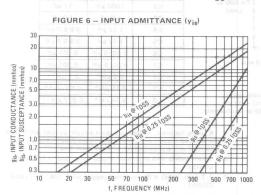
INTERMODULATION CHARACTERISTICS

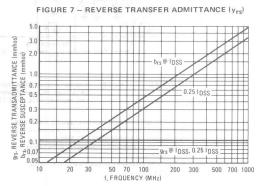
FIGURE 5 - THIRD ORDER INTERMODULATION DISTORTION



COMMON SOURCE CHARACTERISTICS

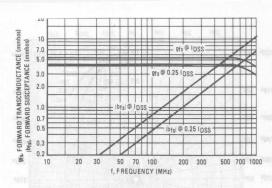
ADMITTANCE PARAMETERS
(VDS = 15 Vdc, T_{Channel} = 25°C)

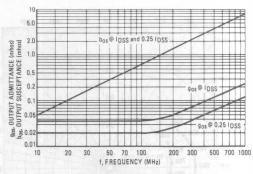




MOTOROLA SMALL-SIGNAL SEMICONDUCTORS







COMMON SOURCE CHARACTERISTICS

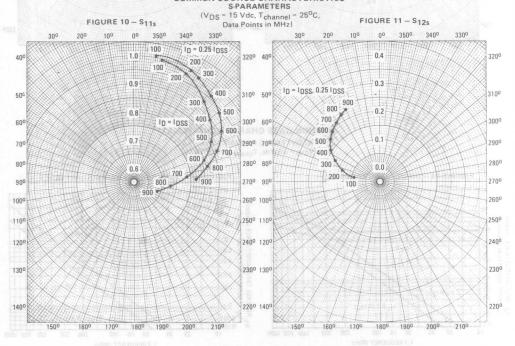
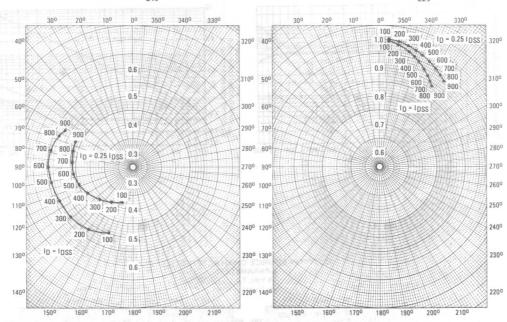


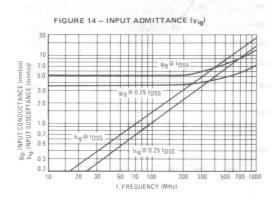


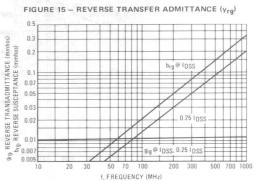
FIGURE 13 - S_{22s}



COMMON GATE CHARACTERISTICS ADMITTANCE PARAMETERS

(V_{DG} = 15 Vdc, T_{channel} = 25°C)







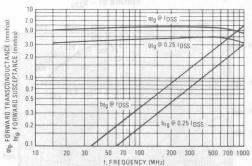
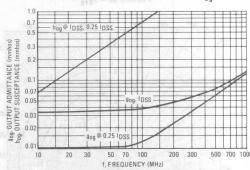
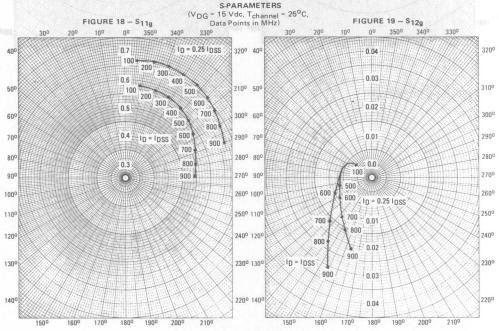


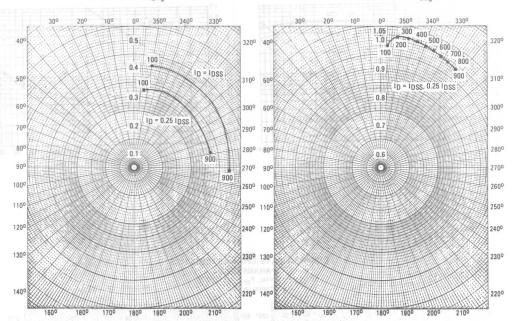
FIGURE 17 - OUTPUT ADMITTANCE (Yog)



COMMON GATE CHARACTERISTICS







MAXIMUM RATINGS

Rating	Symbol	2N4856,A 2N4857,A 2N4858,A	2N4859,A 2N4860,A 2N4861,A	Unit
Drain-Source Voltage	V _{DS}	+40	+30	Vdc
Drain-Gate Voltage	V _{DG}	+40	+30	Vdc
Reverse Gate-Source Voltage	VGSR	-40	-30	Vdc
Forward Gate Current	IGF	A0384VII.5	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	360 2.4		mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +175		°C



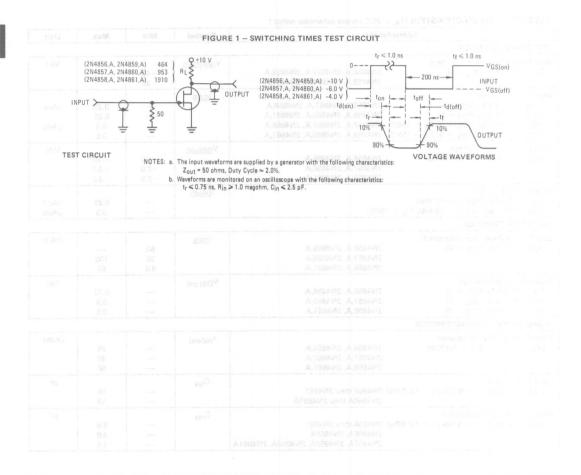
ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Charac	cteristic way your again and any reas _ r	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (I _G = 1.0 μAdc, V _{DS} = 0)	2N4856,A, 2N4857,A, 2N4858,A 2N4859,A, 2N4860,A, 2N4861,A	V(BR)GSS	-40 -30	STATES A SEE SEE	Vdc
Gate Reverse Current (VGS = -20 Vdc, V _{DS} = 0) (VGS = -15 Vdc, V _{DS} = 0) (VGS = -20 Vdc, V _{DS} = 0, T _A = 150° (V _{GS} = -15 Vdc, V _{DS} = 0, T _A = 150°		IGSS		0.25 0.25 0.5 0.5	nAdc μAdc
Gate Source Cutoff Voltage (V _{DS} = 15 Vdc, I _D = 0.5 nAdc)	2N4856,A, 2N4859,A 2N4857,A, 2N4860,A 2N4858,A, 2N4861,A	VGS(off)	-4.0 -2.0 -0.8	-10 -6.0 -4.0	Vdc
Drain Cutoff Current (Vps = 15 Vdc, Vgs = -10 Vdc) (Vps = 15 Vdc, Vgs = -10 Vdc, T _A =	150°C)	ID(off)	_	0.25 0.5	nAdc μAdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(1) (V _{DS} = 15 Vdc, V _{GS} = 0)	2N4856,A, 2N4859,A 2N4857,A, 2N4860,A 2N4858,A, 2N4861,A	IDSS	50 20 8.0	 100 80	mAdc
Drain-Source On-Voltage (ID = 20 mAdc, VGS = 0) (ID = 10 mAdc, VGS = 0) (ID = 5.0 mAdc, VGS = 0)	2N4856,A, 2N4859,A 2N4857,A, 2N4860,A 2N4858,A, 2N4861,A	V _{DS(on)}	=	0.75 0.5 0.5	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Drain-Source "ON" Resistance $(V_{GS} = 0, I_D = 0, f = 1.0 \text{ kHz})$	2N4856,A, 2N4859,A 2N4857,A, 2N4860,A 2N4858,A, 2N4861,A	rds(on)	=	25 40 60	Ohms
Input Capacitance $(V_{DS} = 0, V_{GS} = -10 \text{ Vdc}, f = 1.0 \text{ MHz})$	Hz) 2N4856 thru 2N4861 2N4856A thru 2N4861A	C _{iss}		18 10	pF
Reverse Transfer Capacitance $(V_{DS} = 0, V_{GS} = -10 \text{ Vdc}, f = 1.0 \text{ M})$	hz) 2N4856 thru 2N4861 2N4856A, 2N4859A 2N4857A, 2N4858A, 2N4860A, 2N4861A	C _{rss}	=	8.0 4.0 3.5	pF

	Characteristic		Symbol	Min	Max	Unit
SWITCHING CHARACTE	RISTICS (See Figure 1) (2)		,		•	
Turn-On Delay Time	Conditions for 2N4856,A, 2N4859,A: (VDD = 10 Vdc, ID(on) = 20 mAdc, VGS(on) = 0, VGS(off) = -10 Vdc)	2N4856A, 2N4859A	[†] d(on)	_ _ _ _	6.0 5.0 6.0 6.0 10 8.0	ns
Rise Time	Conditions for 2N4857,A, 2N4860,A: (VDD = 10 Vdc, ID(on) = 10 mAdc, VGS(on) = 0, VGS(off) = -6.0 Vdc)	2N4857,A, 2N4860,A 2N4858, 2N4861	t _r		3.0 4.0 10 8.0	ns
Turn-Off Time	Conditions for 2N4858,A, 2N4861,A: (VDD = 10 Vdc, ID(on) = 5.0 mAdc, VGS(on) = 0, VGS(off) = -4.0 Vdc)	2N4856, 2N4859 2N4856A, 2N4859A 2N4857, 2N4860 2N4857A, 2N4860A	octoff Neav		25 20 50 40 100 80	ns

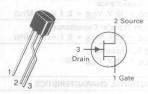
⁽¹⁾ Pulse Test: Pulse Width = 100 ms, Duty Cycle ≤ 10%.

⁽²⁾ The ID(on) values are nominal; exact values vary slightly with transistor parameters.



2N5245 2N5246 2N5247

CASE 29-04, STYLE 23 TO-92 (TO-226AA)



JFET HIGH-FREQUENCY **AMPLIFIER**

N-CHANNEL — DEPLETION

Refer to 2N4416 for graphs.

MAXIMUM RATINGS

9q	Rating	Symbol	Value	Unit
Drain-Gate	Voltage	V _{DG}	30	Vdc
Gate-Source	ce Voltage	VGS	- 30	Vdc
Gate Curre	nt o.cr	IG	50	mA
	ce Dissipation @ T _A = 25°C bove 25°C (Free Air)	PD	360 2.88	mW mW/°C
	ce Dissipation @ T _C = 25°C bove 25°C	PD	500 4.0	mW mW/°C
Lead Temp (1/16" fro	perature om Case for 10 Seconds)	O TL	260 (sHM 003)	°C
Storage Te	emperature Range	T _{stg}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage ($I_G = -1.0 \mu A$, $V_{DS} = 0$)		V _(BR) GSS	-30	-	Vdc
Gate Reverse Current $(V_{GS} = -20 \text{ V}, V_{DS} = 0)$		IGSS	_	- 1.0	nA
Gate 1 Leakage Current $(V_{G1S} = -20 \text{ V}, V_{DS} = 0, T_A = 100^{\circ}\text{C})$		lG1SS	-	-0.5	μΑ
Gate Source Cutoff Voltage $(V_{DS} = 15 \text{ V}, I_D = 10 \text{ mA})$	2N5245 2N5246 2N5247	VGS(off)	- 1.0 - 0.5 - 1.5	-6.0 -4.0 -8.0	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current (VDS = 15 V, VGS = 0, Pulsed: See Note 1)	2N5245 2N5246 2N5247	IDSS	5.0 1.5 8.0	15 7.0 24	mA
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance (VDS = 15 V, VGS = 0, f = 1.0 kHz)	2N5245 2N5246 2N5247	Yfs	4500 3000 4500	7500 6000 8000	μmhos
Input Admittance $(V_{DS} = 15 \text{ V}, V_{GS} = 0)$	(100 MHz) (400 MHz)	Re(yis)	=	100 1000	μmhos
Output Admittance $(V_{DS} = 15 \text{ V}, V_{GS} = 0, f = 1.0 \text{ kHz})$	2N5245 2N5246 2N5247	lyosl	Ξ	50 50 70	μmhos
Output Conductance (V _{DS} = 15 V, V _{GS} = 0)	2N5245 (100 MHz) 2N5246 2N5247 2N5245 (400 MHz) 2N5246 2N5247	Re(y _{OS})		75 75 100 100 100 150	μmhos

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic			Symbol		Min	Max	Unit
Forward Transconductance $(V_{DS} = 15 \text{ V}, V_{GS} = 0, f = 400 \text{ MHz})$ 2N5245 2N5246 2N5247		2N5246		Re(y _{fs})	4000 2500 4000	=	μmhos
Input Capacitance (V _{DS} = 15 V, V _{GS} = 0, f = 1.0 Mhz)				C _{iss}	-	4.5	pF
Reverse Transfer Capacitance (V _{DS} = 15 V, V _{GS} = 0, f = 1.0 MHz)	Sinit Vote	aulaV ne	tar	C _{rss}	p	1.0	pF
Input Susceptance $(V_{DS} = 15 \text{ V}, V_{GS} = 0)$	(100 MH (400 MH			I _M (Yis)	=	3.0 12.0	mmho
FUNCTIONAL CHARACTERISTICS	Wiri	360		9 1	T No.	1 1 - 1	
Noise Figure (VDS = 15 V, ID = 5.0 mA, $R'G = 1.0 \text{ k}\Omega$)	W/m 2/1/Wm	500 5.00 4.0		NF	100 (p)	2.0 4.0	dB
Common Source Power Gain (VDS = 15 V, ID = 5.0 mA, R'G = 1.0 k Ω)		(100 MHz) (400 MHz)		G _{ps}	18 10	110 =	dB
Output Susceptance (VDS = 15 V, VGS = 0)	(100 MH		14	I _M (Yos)	_	1000 4000	μmho

Note 1: tp = 100 ms, Duty Cycle = 10%.

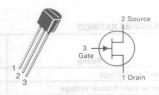
2N5465CASE 29-04, STYLE 7 TO-92 (TO-226AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG}	25	Vdc
Reverse Gate-Source Voltage	VGSR	- 25	Vdc
Gate Current	IG	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Junction Temperature Range	TJ	125	°C
Storage Channel Temperature Range	T _{stg}	-65 to +150	°C

2N5459

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET GENERAL PURPOSE

N-CHANNEL - DEPLETION

Refer to 2N4220 for graphs.

FLECTRICAL	CHARACTERISTICS	(TA =	25°C unless	otherwise noted.)

Hall Kall QVT Characteris	Symbol oit		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					83	HACTERISH	OFF CHA
Gate-Source Breakdown Voltage $(I_G = -10 \mu Adc, V_{DS} = 0)$	ezomajy	2N5461, 2N5482	V(BR)GSS	- 25		ce B <u>re</u> akde D _A Ade, Vge	Vdc
Gate Reverse Current (VGS = -15 Vdc, VDS = 0) (VGS = -15 Vdc, VDS = 0, TA = 100° C)	eeal	ZNS461, ZNS462	GSS	Ξ	2 – <u>D</u> 1	-1.0 -200	nAdc
Gate Source Cutoff Voltage (V _{DS} = 15 Vdc, I _D = 10 nAdc)		2N5457 2N5458	VGS(off)	-0.5 -1.0	S = 0, TA	-6.0 -7.0	Vdc
Vde	(Holdow)	2N5459	Laborate III	- 2.0	spetic	-8.0	und et D
Gate Source Voltage $(V_{DS} = 15 \text{ Vdc}, I_{D} = 100 \mu \text{Adc})$ $(V_{DS} = 15 \text{ Vdc}, I_{D} = 200 \mu \text{Adc})$		2N5457 2N5458	VGS	_	- 2.5 - 3.5	os Voltage	Vdc
$(V_{DS} = 15 \text{ Vdc}, I_{D} = 400 \ \mu\text{Adc})$	SOV	2N5459	Devents .	_	-4.5	gi jobi di	BUV
ON CHARACTERISTICS		hasaite	rasauc	10	bAm 5.0 =	nLaby 27	- 2nV0
Zero-Gate-Voltage Drain Current* (VDS = 15 Vdc, VGS = 0)		2N5457 2N5458 2N5459	IDSS	1.0 2.0 4.0	3.0 6.0 9.0	5.0 9.0 16	mAdc MANG MO
SMALL-SIGNAL CHARACTERISTICS			LODEWS.		10 - 0	Section of	0.1
Forward Transfer Admittance Common Sou (VDS = 15 Vdc, VGS = 0, f = 1.0 kHz)	rce*	2N5457 2N5458 2N5459	Yfs	1000 1500 2000	RACTERISI nitta <u>nc</u> e	5500	μmhos
Output Admittance Common Source* (VDS = 15 Vdc, VGS = 0, f = 1.0 kHz)		2N5464 2N5464 2N5465	Yos	(SPIA ULI	10	50	μmhos
Input Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0 MHz)	lsoyl		C _{iss}	tiffs 0.7	4.5	507.0 mm	A pF
Reverse Transfer Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0 MHz)			C _{rss}	INHM D.C	1.5	3.0	pF pF

*Pulse Test: Pulse Width ≤ 630 ms; Duty Cycle ≤ 10%.

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

2N5457 2N5458 2N5459

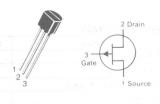
ASE 29-04, STYLE 5 TO-92 (TO-228AA)

MAXIMUM RATINGS

Rating	Symbol	2N5460 2N5461 2N5462	2N5463 2N5464 2N5465	Unit
Drain-Gate Voltage	V _{DG}	40	60	Vdc
Reverse Gate-Source Voltage	VGSR	40	60	Vdc
Forward Gate Current	I _{G(f)}	10		mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82		mW mW/°C
Junction Temperature Range (AMO-M	Range AMAM TJ - 65		+ 135	°C
Storage Channel Temperature Range	T _{stg}	-65 to +150		°C



CASE 29-04, STYLE 7 TO-92 (TO-226AA)



JFET AMPLIFIER

P-CHANNEL - DEPLETION

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.) arrangement of the appropriate and appropriate the control of t

Characteristic lodge 2			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS							
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)		2N5461, 2N5462 2N5464, 2N5465	V(BR)GSS	40 60	n Vollepa De <u> </u>	- A	Vdc
Gate Reverse Current (VGS = 20 Vdc, VDS = 0) (VGS = 30 Vdc, VDS = 0) (VGS = 20 Vdc, VDS = 0, TA = 100°C) (VGS = 30 Vdc, VDS = 0, TA = 100°C)	2N5463, 2N5460,	2N5461, 2N5462 2N5464, 2N5465 2N5461, 2N5462 2N5464, 2N5465	IGSS	гог 56 — Д	15 - 247 1 0 - 317 2020 2020	5.0 5.0 1.0	nAdc μAdc
Gate Source Cutoff Voltage $(V_{DS} = 15 \text{ Vdc}, I_{D} = 1.0 \mu\text{Adc})$	2N5461,	2N5463 2N5464 2N5465	VGS(off)	0.75 1.0 1.8		6.0 7.5 9.0	Vdc
Gate Source Voltage (VDS = 15 Vdc, ID = 0.1 mAdc) (VDS = 15 Vdc, ID = 0.2 mAdc) (VDS = 15 Vdc, ID = 0.4 mAdc)	2N5461,	2N5463 2N5464 2N5465	VGS	0.5 0.8 1.5	AL, fea Bas men—Fra	4.0 4.5 6.0	Vdc
ON CHARACTERISTICS		21/15457			[G 17 [3]]		
Zero-Gate-Voltage Drain Current $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$	2N5461	2N5463 2N5464 2N5465	DSS	1.0 2.0 4.0	NACTERIS	5.0 9.0 16	mAdc
SMALL-SIGNAL CHARACTERISTICS		2015467		13/12/12/1	= 1,0 = 2		
Forward Transfer Admittance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$	2N5461	, 2N5463 , 2N5464 , 2N5465	Yfs	1000 1500 2000	og o <u>rm</u> ero	4000 5000 6000	μmhos
Output Admittance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 kHz)	Cliss		Yos	(se ^W o.t	= 1 2 = 3	75	μmhos
Input Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	Cres		C _{iss}	INTERNATIONAL PROPERTY.	5.0	7.0	pF
Reverse Transfer Capacitance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ MHz})$			C _{rss}	AD APO 18	1.0	2.0	pF
FUNCTIONAL CHARACTERISTICS							
Noise Figure ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $R_G = 1.0 \text{ Megohm}$, $f = 100 \text{ Hz}$, $BW = 1.0 \text{ Hz}$)		NF	-	1.0	2.5	dB	
Equivalent Short-Circuit Input Noise Voltage (VDS = 15 Vdc, VGS = 0, f = 100 Hz, BW = 1.0 Hz)		en	-	60	115	nV/√Hz	

DRAIN CURRENT versus GATE

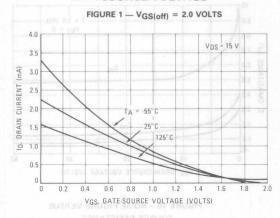


FIGURE 2 — V_{GS(off)} = 4.0 VOLTS

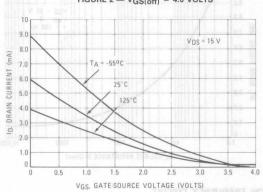
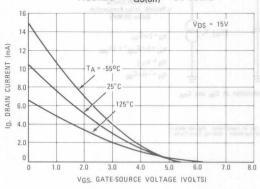


FIGURE 3 - VGS(off) = 5.0 VOLTS



FORWARD TRANSFER ADMITTANCE versus DRAIN CURRENT

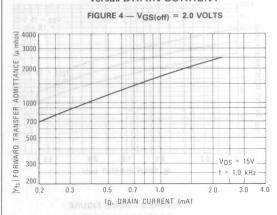


FIGURE 5 — V_{GS(off)} = 4.0 VOLTS

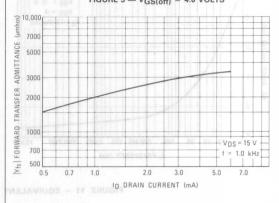
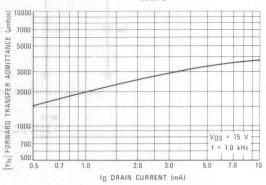
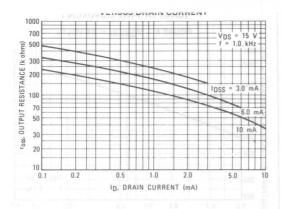


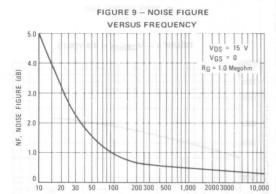
FIGURE 6 - VGS(off) = 5.0 VOLTS







DRAIN-SOURCE VOLTAGE f = 1.0 MHz VGS = 08.0 실 7.0 CAPACITANCE 6.0 Ciss 5.0 4.0 ن 3.0 2.0 Coss Crss 0 10 VDS, DRAIN-SOURCE VOLTAGE (VOLTS)



f, FREQUENCY (Hz)

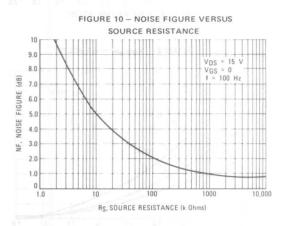
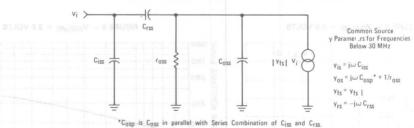


FIGURE 11 - EQUIVALENT LOW FREQUENCY CIRCUIT

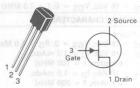


NOTE:

 Graphical data is presented for dc conditions. Tabular data is given for pulsed conditions (Pulse Width 630 ms, Duty Cycle = 10%).

TIITU 2N5486

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET VHF/UHF AMPLIFIER

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

	1000			
Rating	Symbol	Value	Unit	
Drain-Gate Voltage	V _{DG}	25	Vdc	
Reverse Gate-Source Voltage	VGSR	25	Vdc	
Drain Current	ID	30	mAdc	
Forward Gate Current	IG(f)	10	mAdc	
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +150	°C	

Refer to 2N4416 for graphs. **ELECTRICAL CHARACTERISTICS** (T_A = 25°C unless otherwise noted.) Characteristic Symbol Min Тур Max Unit OFF CHARACTERISTICS Gate-Source Breakdown Voltage V(BR)GSS -25 Vdc $(I_G = -1.0 \, \mu Adc, V_{DS} = 0)$ Gate Reverse Current IGSS $(V_{GS} = -20 \text{ Vdc}, V_{DS} = 0)$ -1.0nAdc $(V_{GS} = -20 \text{ Vdc}, V_{DS} = 0, T_{A} = 100^{\circ}\text{C})$ -0.2μAdc Vdc Gate Source Cutoff Voltage VGS(off) (VDS = 15 Vdc, ID = 10 nAdc) 2N5484 -0.3-3.02N5485 -0.5-4.02N5486 -2.0-6.0ON CHARACTERISTICS Zero-Gate-Voltage Drain Current DSS mAdc $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0)$ 2N5484 1.0 5.0 2N5485 4.0 10 2N5486 8.0 20 SMALL-SIGNAL CHARACTERISTICS Forward Transfer Admittance μ mhos Yfs $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$ 2N5484 3000 6000

	2N5485 2N5486		3500 4000	_	7000 8000	
Input Admittance		Re(yis)				μmhos
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100 \text{ MHz})$	2N5484		_	_	100	
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 400 \text{ MHz})$	2N5485, 2N5486			_	1000	
Output Admittance		Yos				μmhos
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$	2N5484		_	_	50	
	2N5485		- 1	_	60	
	2N5486		_	-	75	
Output Conductance		Re(yos)				μmhos
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100 \text{ MHz})$	2N5484		_	_	75	
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 400 \text{ MHz})$	2N5485, 2N5486		_	_	100	
Forward Transconductance		Re(yfs)				μmhos
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100 \text{ MHz})$	2N5484		2500	_	_	
(V _{DS} = 15 Vdc, V _{GS} = 0, f = 400 MHz)	2N5485		3000	_	_	
	2N5486		3500	_	_	

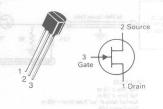
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
Input Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)			C _{iss}	\	_	5.0	pF
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)			C _{rss}	_	_	1.0	pF
Output Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)			C _{oss}	-	_	2.0	pF
FUNCTIONAL CHARACTERISTICS							
Noise Figure			NF		87	W. L. W	dB
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, R_G = 1.0 \text{ Megohm, f}$		value	lodiny2	_	- 911	2.5	
$(V_{DS} = 15 \text{ Vdc}, I_{D} = 1.0 \text{ mAdc}, R_{G} \approx 1.0 \text{ k ohm}, f = 100 \text{ MHz})$	2N5484	25	agV	_		3.0	
$(V_{DS} = 15 \text{ Vdc}, I_{D} = 1.0 \text{ mAdc},$	2N5484	25	изаV	_	4.0	, —	The Hillsh
$R_G \approx 1.0 \text{ k ohm, f} = 200 \text{ MHz}$ $(V_{DS} = 15 \text{ Vdc, I}_D = 4.0 \text{ mAdc,}$	2N5485,	2N5486	g!	_	_	2.0	10
$R_G \approx 1.0 \text{ k ohm, f} = 100 \text{ MHz}$		1.0	1001				E SVET
$(V_{DS} = 15 \text{ Vdc}, I_D = 4.0 \text{ mAdc},$ $R_G \approx 1.0 \text{ k ohm}, f = 400 \text{ MHz})$	2N5485,	2N5486	QQ.	70 81	= giTtima	4.0	
Common Source Power Gain (V _{DS} = 15 Vdc, I _D = 1.0 mAdc, f = 100 MHz) (V _{DS} = 15 Vdc, I _D = 1.0 mAdc, f = 200 MHz)	2N5484 2N5484	951 + 01 68 -	G _{ps}	16	14	25	dB
(V _{DS} = 15 Vdc, I _D = 4.0 mAdc, f = 100 MHz) (V _{DS} = 15 Vdc, I _D = 4.0 mAdc, f = 400 MHz)	2N5485, 2N5485,			18 10		30 20	

	E.0-		

2N5555

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET SWITCHING

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

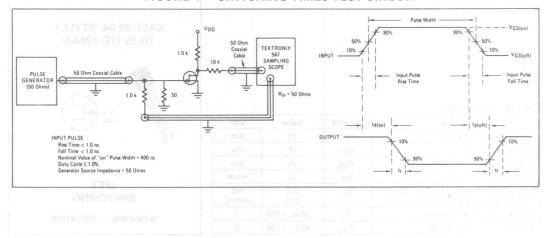
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG}	25	Vdc
Gate-Source Voltage	VGS	25	Vdc
Forward Gate Current	IGF	10	mAdc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Junction Temperature Range	TJ	-65 to +150	°C
Storage Temperature Range	T _{stg}	- 65 to + 150	°C

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

	Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	S Char				
Gate-Source Breakdown (I _G = 10 μAdc, V _{DS} =		V(BR)GSS	25	_	Vdc
Gate Reverse Current (V _{GS} = 15 Vdc, V _{DS}	= 0)	IGSS		1.0	nAdc
Drain Cutoff Current (VDS = 12 Vdc, VGS (VDS = 12 Vdc, VGS	= -10 V) = -10 V, T _A = 100°C)	I _{D(off)}	Ξ	10 2.0	nAdc μAdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain (V _{DS} = 15 Vdc, V _{GS}	IDSS	15	_	mAdc	
Gate-Source Forward Vo		V _{GS(f)}	-	1.0	Vdc
Drain-Source On-Voltage (ID = 7.0 mAdc, VGS		VDS(on)	-	1.5	Vdc
Static Drain-Source On (ID = 0.1 mAdc, VGS		rDS(on)		150	Ohms
SMALL-SIGNAL CHARA	ACTERISTICS				
Small-Signal Drain-Source "ON" Resistance (VGS = 0, ID = 0, f = 1.0 kHz)		rds(on)	и (; <u>—</u> » — ;	150	Ohms
Input Capacitance (V _{DS} = 15 Vdc, V _{GS}	= 0, f = 1.0 MHz)	C _{iss}	_	5.0	pF
Reverse Transfer Capacitance (V _{DS} = 0, V _{GS} = 10 Vdc, f = 1.0 MHz)		C _{rss}	_	1.2	pF
SWITCHING CHARACTI	ERISTICS				
Turn-On Delay Time	$(V_{DD} = 10 \text{ Vdc}, I_{D(on)} = 7.0 \text{ mAdc},$	t _d (on)		5.0	ns
Rise Time	$V_{GS(on)} = 0$, $V_{GS(off)} = -10 \text{ Vdc}$ (See Figure 1)	t _r	_	5.0	ns
Turn-Off Delay Time	$(V_{DD} = 10 \text{ Vdc}, I_{D(on)} = 7.0 \text{ mAdc},$	t _{d(off)}		15	ns
Fall Time	$V_{GS(on)} = 0$, $V_{GS(off)} = -10 \text{ Vdc}$ (See Figure 1)	tf	-	10	ns

^{*}Pulse Test: Pulse Width < 300 μ s, Duty Cycle < 3.0%.

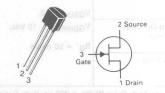
FIGURE 1 — SWITCHING TIMES TEST CIRCUIT



6

2N5640

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET SWITCHING

N-CHANNEL — DEPLETION

Refer to 2N5653 for graphs.

MAXIMUM RATINGS

Reverse Transfer Capacitance

 $(V_{DS} = 0, V_{GS} = -12 \text{ Vdc}, f = 1.0 \text{ MHz})$

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	30	Vdc
Drain-Gate Voltage	VDG	30	Vdc
Reverse Gate-Source Voltage	VGSR	30	Vdc
Forward Gate Current	IGF	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Junction Temperature Range	TJ	-65 to +150	°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) Characteristic Symbol Min Max Unit **OFF CHARACTERISTICS** Gate-Source Breakdown Voltage V(BR)GSS 30 Vdc $(I_G = 10 \, \mu Adc, V_{DS} = 0)$ Gate Reverse Current IGSS $\begin{array}{lll} (V_{GS} = \, -15 \; Vdc, \, V_{DS} = \, 0) \\ (V_{GS} = \, -15 \; Vdc, \, V_{DS} = \, 0, \, T_{A} \, = \, 100^{\circ}C) \end{array}$ 1.0 nAdc 1.0 μAdc **Drain Cutoff Current** ID(off) $(V_{DS} = 15 \text{ Vdc}, V_{GS} = -12 \text{ Vdc})$ 2N5638 1.0 nAdc $(V_{DS} = 15 \text{ Vdc}, V_{GS} = -8.0 \text{ Vdc})$ 2N5639 1.0 $(V_{DS} = 15 \text{ Vdc}, V_{GS} = -6.0 \text{ Vdc})$ 2N5640 1.0 $(V_{DS} = 15 \text{ Vdc}, V_{GS} = -12 \text{ Vdc}, T_{A} = 100^{\circ}\text{C})$ 2N5638 1.0 μAdc (V_{DS} = 15 Vdc, V_{GS} = -8.0 Vdc, T_A = 100°C) (V_{DS} = 15 Vdc, V_{GS} = -6.0 Vdc, T_A = 100°C) 2N5639 1.0 2N5640 1.0 ON CHARACTERISTICS Zero-Gate-Voltage Drain Current(1) IDSS mAdc $(V_{DS} = 20 \text{ Vdc}, V_{GS} = 0)$ 2N5638 50 2N5639 25 2N5640 5.0 Drain-Source On-Voltage Vdc V_{DS}(on) 2N5638 $(I_D = 12 \text{ mAdc}, V_{GS} = 0)$ 0.5 $(I_D = 6.0 \text{ mAdc}, V_{GS} = 0)$ 2N5639 0.5 2N5640 $(I_D = 3.0 \text{ mAdc}, V_{GS} = 0)$ 0.5 Static Drain-Source On Resistance Ohms rDS(on) 2N5638 $(I_D = 1.0 \text{ mAdc}, V_{GS} = 0)$ 30 2N5639 60 2N5640 100 **SMALL-SIGNAL CHARACTERISTICS** Static Drain-Source "ON" Resistance Ohms rds(on) 2N5638 $(V_{GS} = 0, I_{D} = 0, f = 1.0 \text{ kHz})$ 30 2N5639 60 2N5640 100 Input Capacitance Ciss 10 $(V_{DS} = 0, V_{GS} = -12 \text{ Vdc}, f = 1.0 \text{ MHz})$

 C_{rss}

4.0

pF

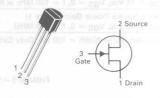
Characteristic					Min	Max	Unit
SWITCHING CHAR	RACTERISTICS						
Turn-On Delay Time	CASE 29-04, ST	I _{D(on)} = 12 mAdc 6.0 mAdc 3.0 mAdc	2N5638 2N5639 2N5640	^t d(on)		4.0 6.0 8.0	ns
Rise Time	$V_{DD} = 10 \text{ Vdc},$ $V_{GS(on)} = 0,$	I _{D(on)} = 12 mAdc 6.0 mAdc 3.0 mAdc	2N5638 2N5639 2N5640	tr		5.0 8.0 10	ns
Turn-Off Delay Time	$V_{GS(off)} = -10 \text{ Vdc},$ $R_{G'} = 50 \text{ ohms}$	I _{D(on)} = 12 mAdc 6.0 mAdc 3.0 mAdc	2N5638 2N5639 2N5640	td(off)	=	5.0 10 15	ns
Fall Time	ated 2	I _{D(on)} = 12 mAdc 6.0 mAdc 3.0 mAdc	2N5638 2N5639 2N5640	agV _{tf}	=	10 20 30	ns

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 3.0%.

O	r	2	
_	r	0	
	B.	-	

2N5668 2N5669 2N5670

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET VHF AMPLIFIER

N-CHANNEL — DEPLETION

Max

Unit

Symbol

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	VDG	25 74 17	Vdc
Reverse Gate-Source Voltage	VGSR	25	Vdc
Drain Current	ID	20	mAdc
Forward Gate Current	I _{G(f)}	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Storage Channel Temperature Range	T _{stg}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic

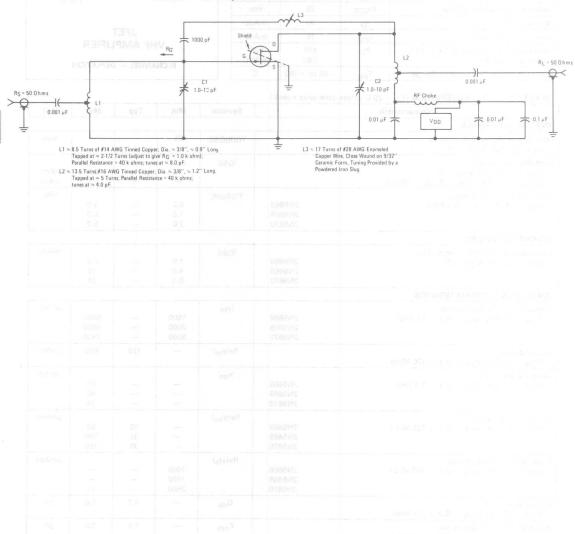
Olidi dotolistic	Oymbor	191111	1 1 1	IVIGA	Oilit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)	V(BR)GSS	25	mand psent (V	SE ME in some Call	Vdc
Gate Reverse Current $(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0, T_{A} = 100^{\circ}\text{C})$	IGSS	Self and and	All A select terms All A select terms From — Carnet Parkly floring	2.0 2.0	nAdc μAdc
Gate Source Cutoff Voltage (VDS = 15 Vdc, ID = 10 nAdc) 2N56 2N56 2N56	69	0.2 1.0 2.0	=	4.0 6.0 8.0	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(1) (VDS = 15 Vdc, VGS = 0) 2N56 2N56	69	1.0 4.0 8.0	=	5.0 10 20	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance $ (V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz}) $ $ 2N56 $ $ 2N56 $ $ 2N56 $	69	1500 2000 3000	=	6500 6500 7500	μmhos
Input Admittance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 100 MHz)	Re(yis)	-	125	800	μmhos
Output Admittance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$ 2N56 2N56 2N56	69	=	=	20 50 75	μmhos
Output Conductance $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100 \text{ MHz})$ 2N56 2N56 2N56	669	Ξ	10 25 35	50 100 150	μmhos
Forward Transconductance ($V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100 \text{ MHz}$) 2N56 2N56	669	1000 1600 2500	=	=	μmhos
Input Capacitance $(V_{DS}=15\ Vdc,\ V_{GS}=0,\ f=1.0\ MHz)$	C _{iss}	-	4.7	7.0	pF
Reverse Transfer Capacitance (Vps = 15 Vdc, Vgs = 0, f = 1.0 MHz)	C _{rss}	-	1.0	3.0	pF

Output Capacitance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 MHz)	Coss	_	1.4	4.0	pF
FUNCTIONAL CHARACTERISTICS					
Noise Figure (Figure 1) OT $SB-OT$ $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100 \text{ MHz at R}_{G}' = 1.0 \text{ k ohm})$	NF	_	-	2.5	dB
Common Source Power Gain (Figure 1) (Vps = 15 Vdc, Vgs = 0, f = 100 MHz)	G _{ps}	16	-	_	dB

⁽¹⁾ Pulse Test: Pulse Width = 100 ms, Duty Cycle ≤ 10%.

6

FIGURE 1 - 100 MHz, POWER GAIN AND NOISE FIGURE TEST CIRCUIT



Rating	Symbol	2N6659 MPF6659	2N6660 MPF6660	2N6661 MPF6661	Unit
Drain-Source Voltage	VDS	35	60	90	Vdc
Drain-Gate Voltage	V _{DG}	35	60	90	Vdc
Gate-Source Voltage	VGS	×1	± 30		Vdc
Drain Current — Continuous (1) Pulsed (2)	I _D	37 no!	2.0		Adc
- 5.0 ns		2N665 2N666 2N666	0 N	1PF6659 1PF6660 1PF6661	,ô
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	6.25 50		2.5 20	Watts mW/°C
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD			1.0	
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150			°C

(1) The Power Dissipation of the package may result in a lower continuous drain current.

(2) Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

2N6659 2N6660 2N6661 MPF6659 MPF6660 MPF6661

2N6659,60,61 CASE 79-02, STYLE 6 TO-39 (TO-205AD)



MPF6659,60,61 CASE 29-03, STYLE 22 TO-226AE



TMOS SWITCHING TRANSISTOR N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS	(TA	= 25°C	unless	otherwise	noted.)
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Characteristic	word.			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	Difficulti				1 2007 0	1		
Zero-Gate-Voltage Drain Current (V _{DS} = Maximum Rating, V _{GS} = 0)	IV tuant			IDSS	# _	+ -+	10	μAdc
Gate-Body Leakage Current (VGS = 15 V, VDS = 0)	- P SAUDIR		2R/J	IGSS	200 V 0331.	L NORWA	100	nAdc
Drain-Source Breakdown Voltage (V _{GS} = 0, I _D = 10 μA)	2N6659, N 2N6660, N 2N6661, N	1PF6660		V(BR)DSX	35 60 90	Ī		Vdc
ON CHARACTERISTICS(1)				Amou = 0				1
Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 1.0 mA)				V _{GS} (Th)	0.8	1.4	2.0	Vdc
Drain-Source On-Voltage (VGS = 10 V, I _D = 1.0 A)	2N6659, N 2N6660, N 2N6661, N	/IPF6660		V _{DS(on)}		<u> </u>	1.8 3.0 4.0	Vdc
$(V_{GS} = 5.0 \text{ V}, I_D = 0.3 \text{ A})$	2N6659, N 2N6660, N 2N6661, N	1PF6660	21			0.8 0.9 0.9	1.5 1.5 1.6	
Static Drain-Source On Resistance (VGS = 10 Vdc, I _D = 1.0 Adc)	2N6659, N 2N6660, N 2N6661, N	/IPF6660		rDS(on)	UTARBUMBT.	Ty JUNCTION	1.8 3.0 4.0	Ohms
On-State Drain Current (V _{DS} = 25 V, V _{GS} = 10 V)		501 (Val	I _{D(on)}	1.0	2.0	-	Amps
SMALL-SIGNAL CHARACTERISTICS							and the same of th	
Input Capacitance (Vps = 25 V, Vgs = 0, f = 1.0 MHz)		08	Vale	C _{iss}		30	50	pF
Reverse Transfer Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)		08-12		C _{rss}	1-1	3.6	10	pF
Output Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	114	a 3	V Oak	Coss		20	40	pF
Forward Transconductance (V _{DS} = 25 V, I _D = 0.5 A)	-		vel.	9fs	170			mmho

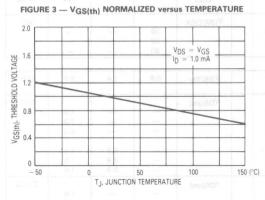
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

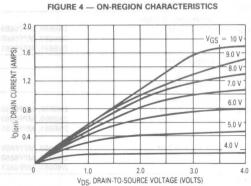
Characteristic			Symbol	Min	Тур	Max	Unit
SWITCHING CHARACTERISTICS(1)	ohV:	08 0	35	Fay !		35	
Rise Time	bbV	30	² t _r	Vas	_	5.0	ns
Fall Time	Adc		tf	-	_	5.0	ns
Turn-On Time			ton	1.00	_	5.0	ns
Turn-Off Time	1000		toff	_	_	5.0	ns

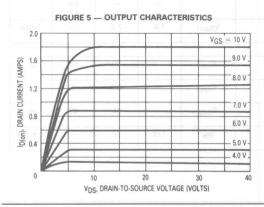
(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

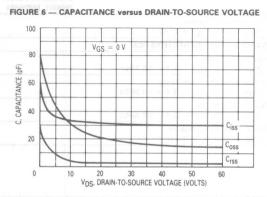
RESISTIVE SWITCHING

FIGURE 1 — SWITCHING TEST CIRCUIT FIGURE 2 — SWITCHING WAVEFORMS To Sampling Scope toff -50 Ω Attenuator Pulse Generator 9 40 pF 1(+ Output Vout 10% \$50 Ω \$ 1.0 MΩ 90% 10 V 50% 50% Pulse Input Vin -



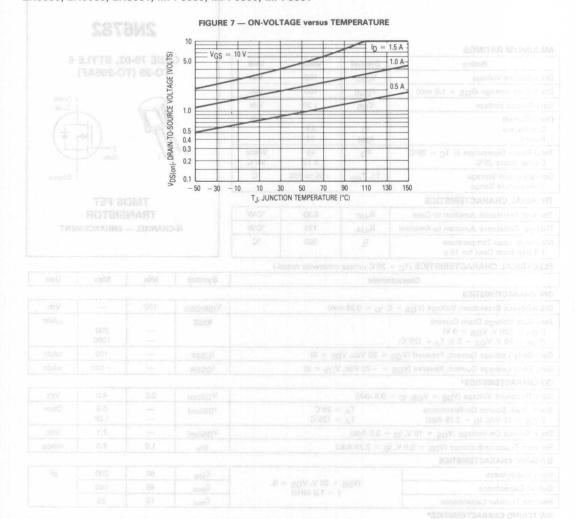






MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

2N6659, 2N6660, 2N6661, MPF6659, MPF6660, MPF6661



MAYIMI IM DATINGS

MAXIMUM KATINGS						
Rating	Symbol	Value	Unit			
Drain-Source Voltage	VDSS	100	Vdc			
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	100	Vdc			
Gate-Source Voltage	VGS	± 20	Vdc			
Drain Current Continuous Pulsed	I _D	3.5 14	Adc			
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	15 0.12	Watts W/°C			
Operating and Storage Temperature Range	TJ, T _{stg}	-55 to 150	°C			

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	8.33	°C/W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	175	°C/W
Maximum Lead Temperature 1.6 mm from Case for 10 s	TL	300	°C

2N6782

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



N. SWSEST, MPFESSS, N. PFSSS, MPFESST



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Cha	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (VGS	$S = 0, I_D = 0.25 \text{ mA}$	V(BR)DSS	100	_	Vdc
Zero Gate Voltage Drain Current (V _{DS} = 100 V, V _{GS} = 0 V) (V _{DS} = 80 V, V _{GS} = 0 V, T _J = 125'	IDSS	_	250 1000	μAdo	
Gate-Body Leakage Current, Forward ($V_{GS} = 20 \text{ Vdc}, V_{DS} = 0)$	IGSSF	_	100	nAdd
Gate-Body Leakage Current, Reverse ($V_{GS} = -20 \text{ Vdc}, V_{DS} = 0)$	IGSSR	_	- 100	nAdo
ON CHARACTERISTICS*					
Gate Threshold Voltage (V _{DS} = V _{GS} ,	$I_D = 0.5 \text{ mA}$	V _{GS(th)}	2.0	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 2.25 Adc)	rDS(on)	=	0.6 1.08	Ohm	
Drain-Source On-Voltage ($V_{GS} = 10 \text{ V}$	V _{DS(on)}	_	2.1	Vdc	
Forward Transconductance ($V_{DS} = 5$.	9fs	1.0	3.0	mhos	
DYNAMIC CHARACTERISTICS					
Input Capacitance		Ciss	60	200	pF
Output Capacitance	$(V_{DS} = 25 \text{ V}, V_{GS} = 0,$ f = 1.0 MHz)	Coss	40	100	
Reverse Transfer Capacitance	1 - 1.0 (4112)	C _{rss}	10	25	
SWITCHING CHARACTERISTICS*					
Turn-On Delay Time		td(on)	_	15	ns
Rise Time	(V _{DD} ≈ 34 V, I _D = 2.25 Rated I _D ,	t _r	_	25	
Turn-Off Delay Time	R _{gen} = 50 ohms)	td(off)	_	25	
Fall Time		tf	_	20	
SOURCE-DRAIN DIODE CHARACTERIS	STICS*				
Diode Forward Voltage		V _{SD}	0.75	1.5	Vdc
Forward Turn-On Time	$(I_S = Rated I_{D(on)}, V_{GS} = 0)$	ton	-	Negligible	ns
Reverse Recovery Time	765 - 07	t _{rr}	_	200	ns

DOUGLE J -- ON-VOLTAGE VIRGUS TEMPSTURE

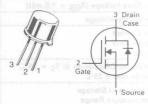
^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

IVIAXIIVIOIVI KATINGS			
Rating Rating	Symbol	Value	Unit
Drain-Source Voltage	VDSS	200	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	200	Vdc
Gate-Source Voltage	VGS	35 ± 20	Vdc
Drain Current Continuous Pulsed	I _D	2.25 9.0	Adc
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	15 0.12	Watts W/°C
Operating and Storage Temperature Range	TJ, T _{stg}	-55 to 150	ed se °C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	8.33	°C/W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	175	°C/W
Maximum Lead Temperature 1.6 mm from Case for 10 s	TL	300	0° 300

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

tinti xaM aiM Ch	Symbol	Min	Max	Unit		
OFF CHARACTERISTICS					CLEMENOS	ARAHO TO
Drain-Source Breakdown Voltage (VG	s = 0, ID =	0.25 mA) (Arx 80)	V(BR)DSS	200	n Bre uk down	Vdc
Zero Gate Voltage Drain Current (VDS = Rated VDSS, VGS = 0) (VDS = 0.8 Rated VDSS, VGS = 0, TJ = 125°C)				Current GS = 0) TL = 125Y	250 1000	μAdc
Gate-Body Leakage Current, Forward	(VGS = 20 '	Vdc, V _{DS} = 0) (0 = prov a	IGSSF	int. E or ward	100	nAdc
Gate-Body Leakage Current, Reverse	$V_{GS} = -20$) Vdc, V _{DS} = 0) (0 = adV .ab	IGSSR	enevañ de	- 100	nAdc
ON CHARACTERISTICS*					CLEUR LICE	MARAHO VIC
Gate Threshold Voltage (VDS = VGS,	I _D = 0.5 m	A)	V _{GS(th)}	2.0	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 1.5 Adc)	*DS(on)	T _A = 25°C Ords AT T _A = 125°C Ords AT	rDS(on)	esistemos .5 Au u s	1.5 2.81	Ohm
Drain-Source On-Voltage (VGS = 10	V, I _D = 2.25	Adc)	V _{DS(on)}	(Vast= 10)	3.37	Vdc
Forward Transconductance (V _{DS} = 5.	.0 V, ID = 1.	5 Adc) (55A	9fs V0	0.9	2.7	mhos
DYNAMIC CHARACTERISTICS						
Input Capacitance	140	nei)		60	200	pF pF
Output Capacitance	zec2	$(V_{DS} = 25 \text{ V}, V_{GS} = 0, f = 1.0 \text{ MHz})$	Coss	20	80	
Reverse Transfer Capacitance	Cree	The integral of the state of th	C _{rss}	5.0	25	
SWITCHING CHARACTERISTICS*				*apriles*		
Turn-On Delay Time	(no)b)		td(on)	_	15	ns
Rise Time 07		$(V_{DD} \approx 75 \text{ V}, I_{D} = 1.5 \text{ A},$	t _r	-	20	
Turn-Off Delay Time	(No)b ²	Rgen = 50 ohms)	td(off)	-	30	
Fall Time	37		tf	_	20	
SOURCE-DRAIN DIODE CHARACTERIS	STICS*		*8000	HARACTERIS	D BRODE MAN	IC-BURGO-DI
Diode Forward Voltage	dsV		V _{SD}	0.7	1.5/ 618	Vdc
Forward Turn-On Time	ton	$V_{GS} = 0$	ton	_	Negligible	ns
Reverse Recovery Time	land.	.09 of 10 = 80 A	t _{rr}	290 (Typ)	eini F vrevor	ns

^{*}Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	100	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	100	Vdc
Gate-Source Voltage	VGS	± 20	Vdc
Drain Current Continuous Pulsed	I _D	6.0 24	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	20 0.16	Watts W/°C
Operating and Storage Temperature Range	TJ, T _{stg}	-55 to 150	ot 99 °C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	6.25	E.B °C/W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	WO 175	**C/W
Maximum Lead Temperature	TL	300	°C

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

2N6788

CASE 79-03, STYLE 6 TO-39 (TO-205AF)





TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

zieU xeM HBA Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						St. Oct. 18
Drain-Source Breakdown Voltage (Vo	s = 0, I _D =	0.25 mA) (Am 35.	V(BR)DSS	100	1146.00	Vdc
Zero Gate Voltage Drain Current (VDS = Rated VDSS, VGS = 0) (VDS = 80 V, VGS = 0, TJ = 125° C	550		I _{DSS}	106 (10. 16— 11. 11. 11. 17.	1.0 4.0	mA
Gate-Body Leakage Current, Forward (VGS = 20 Vdc, VDS = 0)		GSSF	hiss <u>—</u> 1 ir	100	nAdc	
Gate-Body Leakage Current, Reverse (V _{GS} = -20 Vdc, V _{DS} = 0)			IGSSR	38 to <u>44</u> 1	-100	nAdc
ON CHARACTERISTICS*					*2 ITEM	17 1 11
Gate Threshold Voltage (VDS = VGS	, I _D = 1.0 m	nA)	VGS(th)	2.0	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 3.5 Adc)	(46)20)	$T_A = 25^{\circ}C$ $T_A = 125^{\circ}C$	rDS(on)	803 <u></u> 06 5 /3 <u>6</u>	0.3 0.54	Ohm
Drain-Source On-Voltage (V _{GS} = 10 V, I _D = 6.0 Adc)			V _{DS(on)}	11 - 11 m	1.8	Vdc
Forward Transconductance (V _{DS} = 5.0 V, I _D = 3.5 Adc)		9fs	1.5	4.5	mhos	
DYNAMIC CHARACTERISTICS				8,011	THE FOLLOW	1211 7477
Input Capacitance	Ciss		Ciss	200	600	pF
Output Capacitance	Coss	$(V_{DS} = 25 \text{ V}, V_{GS} = 0,$ f = 1.0 MHz)	Coss	100	400	
Reverse Transfer Capacitance	Cyss	1 = 1.0 WHZ	C _{rss}	20	100	
SWITCHING CHARACTERISTICS*				# PETATR	RETTARKS	TELL Than
Turn-On Delay Time	(colb)		t _{d(on)}	_	40	ns
Rise Time	Tr.	$(V_{DD} \approx 35 \text{ V}, I_{D} = 3.5 \text{ A},$	√) t _r	_	70	
Turn-Off Delay Time	(Hola)	R _{gen} = 50 ohms)	t _d (off)		40	
Fall Time	11		t _f	_	70	
SOURCE-DRAIN DIODE CHARACTERI	STICS*		120706	BETTOMBOL	darah Ir	1 4. (4)
Diode Forward Voltage	pas.		V _{SD}	0.8	1.8	Vdc
Forward Turn-On Time	no ¹	$(I_S = Rated I_{D(on)}, V_{GS} = 0)$	ton	-	Negligible	ns
Reverse Recovery Time 1997 985	137	VGS - 0/	t _{rr}	_	230	ns

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

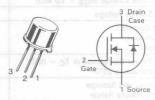
MAXIMOM NATINGO						
Rating	Symbol	Value	Unit			
Drain-Source Voltage	VDSS	200	Vdc			
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	200	Vdc			
Gate-Source Voltage	VGS	±20	Vdc			
Drain Current Continuous Pulsed	I _D	3.5 14	Adc			
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	20 0.16	Watts W/°C			
Operating and Storage Temperature Range	T _J , T _{stg}	-55 to 150	1 gg ∘C B			

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta}JC$	6.25	°C/W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	175	°C/W
Maximum Lead Temperature 1.6 mm from Case for 10 s	TL	300	°C

2N6790

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

tint/ xsiv niv Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					ACTERISTOR	HARD TY
Drain-Source Breakdown Voltage (VG	s = 0, I _D =	0.25 mA) (Am 85.)	V(BR)DSS	200	nweb/ <u>Le</u> nS oc	Vdc
Zero Gate Voltage Drain Current $(V_{DS} = Rated\ V_{DSS},\ V_{GS} = 0)$ $(V_{DS} = 0.8\ Rated\ V_{DSS},\ V_{GS} = 0,$	22d T _J = 125°C)	IDSS	Correct GS = 0) TJ= 125	250	μAdc
Gate-Body Leakage Current, Forward (VGS = 20 Vdc, VDS = 0)		IGSSF	ni, <u>io</u> rviat	100	nAdc	
Gate-Body Leakage Current, Reverse	$(V_{GS} = -2)$	0 Vdc, V _{DS} = 0)	IGSSR	nt, <u>Re</u> versi	-100	nAdc
ON CHARACTERISTICS*					*corenierios*	HAND N
Gate Threshold Voltage (VDS = VGS	ID = 1.0 m	iA)	V _G S(th)	2.0	9 eget 4.0 blod	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, I _D = 2.25 Adc)	(ne)2G1	$T_A = 25^{\circ}C$ $T_A = 125^{\circ}C$	rDS(on)	esistance 0 Ade)		Ohm
Drain-Source On-Voltage (VGS = 10 V, ID = 3.5 Adc)		V _{DS(on)}	ir = <u>eg</u> V)	2.8	Vdc	
Forward Transconductance (V _{DS} = 5.0 V, I _D = 2.25 Adc)		9fs	1.5	4.5	mhos	
DYNAMIC CHARACTERISTICS						
Input Capacitance	Cins	6	Ciss	200	600	pF
Output Capacitance	Coss	$(V_{DS} = 25 \text{ V}, V_{GS} = 0,$ f = 1.0 MHz)	Coss	60	300	
Reverse Transfer Capacitance	Cras	1.0 111127	C _{rss}	15	80	
SWITCHING CHARACTERISTICS*						
Turn-On Delay Time	(no)p ¹		t _{d(on)}		40	ns
Rise Time	11	$(V_{DD} \approx 74 \text{ V}, I_{D} = 2.25 \text{ A},$	t _r		50	
Turn-Off Delay Time	(ha)b ¹	R _{gen} = 50 ohms)	td(off)		50	
Fall Time	47		tf		50	
SOURCE-DRAIN DIODE CHARACTERIS	STICS*		*BOTTOS*	HARACTE	RAIN DIODE C	SOME O
Forward Diode Voltage	gsV		V _{SD}	0.7	1.5	Vdc
Forward Turn-On Time	not	$(I_S = Rated I_{D(on)}, V_{GS} = 0)$	ton		Negligible	ns
Reverse Recovery Time	tor	VGS - 01	t _{rr}		350	ns

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

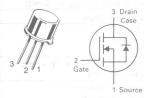
WAXINOW NATINGS						
Rating Rating	Symbol	Value	W Unit			
Drain-Source Voltage	V _{DSS}	100 g	y Vdc			
Drain-Gate Voltage (R _{GS} = 1.0 m Ω)	VDGR	55V 100	Vdc			
Gate-Source Voltage	VGS	bby ±20	Vdc			
Drain Current Continuous Pulsed	I _D	8.0 32	Adc			
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	25 0.2	Watts W/°C			
Operating and Storage Temperature Range	TJ, Tstg	∋−55 to 150	O° BB b			

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	5.0	°C/W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	AAC 175	°C/W
Maximum Lead Temperature 1.6 mm from Case for 10 s	TL	300	OOE °C

ZNO/JO

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

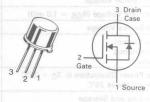
MANU MAN Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS			BOEL HULLINGS	Tago Te
Drain-Source Breakdown Voltage (VGS = 0, ID = 0.25 mA)	V(BR)DSS	100	Annual Turan	Vdc
Zero Gate Voltage Drain Current (VDS = Rated VDSS, VGS = 0) (VDS = 80 V, VGS = 0, T_J = 125°C)	IDSS	//16"/ //15 = 0) c V//c = (250 1000	μAdc
Gate-Body Leakage Current, Forward (VGS = 20 Vdc, VDS = 0)	IGSSE	716-V/1 07 -176	100	nAdc
Gate-Body Leakage Current, Reverse (VGS = -20 Vdc, VDS = 0)		eneven Jes	- 100	nAdc
ON CHARACTERISTICS*			National To	100 3 1,410
Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 0.5 mA)	VGS(th)	2.0	4.0	Vdc
Static Drain-Source On-Resistance $(V_{GS} = 10 \text{ Vdc}, I_D = 5.0 \text{ Adc})$ $T_A = 125^{\circ}\text{C}$	rDS(on)	50/ 0 710/6 10 0/4 32.3	0.18 0.35	Ohm
Drain-Source On-Voltage (VGS = 10 V, ID = 8.0 Adc)	VDS(on)	H a nv	1.56	Vdc
Forward Transconductance (V _{DS} = 15 V, I _D = 5.0 Adc)	9fs v 0 a	3.0	9.0	mhos
DYNAMIC CHARACTERISTICS		80(18	MIERO WES	SINGLE PURS
Input Capacitance	C _{iss}	350	900	pF
Output Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MHz)	Coss	150	500	
Reverse Transfer Capacitance	C _{rss}	50	150	1290 00
SWITCHING CHARACTERISTICS*		SISTIGS*		
Turn-On Delay Time	td(on)	_	30	ns
Rise Time $(V_{DD} \approx 30 \text{ V}, I_{D} = 5.0 \text{ Adc},$	t _r		75	
Turn-Off Delay Time Rgen = 50 ohms)	td(off)	(-	40	e ar a.
Fall Time 03	tf	_	45	a 51 111
SOURCE-DRAIN DIODE CHARACTERISTICS*				
Diode Forward Voltage	V _{SD}	0.75	1.5	Vdc
Forward Turn-On Time (Is = Rated ID(on), VGS = 0)	ton	-	Negligible	ns
Reverse Recovery Time	t _{rr}	_	300	ns

MAXIMUM RATINGS					
Rating	Symbol	Value	Unit		
Drain-Source Voltage	VDSS	abV 200	Vdc		
Drain-Gate Voltage (R _{GS} = 1.0 m Ω)	VDGR	abV 200	€€ Vdc		
Gate-Source Voltage	VGS	30V ± 20	Vdc		
Drain Current Continuous Pulsed	I _D	5.5 22	Adc 0.8		
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	25 0.2	Watts W/°C		
Operating and Storage Temperature Range	T _J , T _{stg}	-55 to 150	or acc		

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	5.0	0.8°C/W
Maximum Lead Temperature 1.6 mm from Case for 10 s	TL	300	008 °C

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR N-CHANNEL — ENHANCEMENT

Max Unit	Chi	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						BOTTERETT	OHARAH
Drain-Source Breakdown	Voltage (VG	s = 0, I _D =	0.25 mA)	V(BR)DSS	200	Breakdown	Vdc
Zero Gate Voltage Drain C (VDS = Rated VDSS, VC (VDS = 0.8 Rated VDSS	GS = 0	82gl TJ = 125°C)	IDSS (CHOCK) = (128°C)	1nemus (2 = 85 (2 = 0)	250 1000	μAdc
Gate-Body Leakage Curre	nt, Forward	$V_{GS} = 20$	Vdc, V _{DS} = 0)	IGSSF	nt, Et im vand	100	nAdc
Gate-Body Leakage Current, Reverse (VGS = -20 Vdc, VDS = 0)				IGSSR	nt, R or asa (- 100	nAdc
ON CHARACTERISTICS*						TERISTICS*	DARAHO
Gate Threshold Voltage (\	DS = VGS,	$I_D = 0.5 \text{ m}$	A)	VGS(th)	2.0 20	4.0	Vdc
Static Drain-Source On-Re (VGS = 10 Vdc, ID = 3.		(na)2d1	$T_A = 25^{\circ}C$ $T_A = 125^{\circ}C$	rDS(on)		0.4	Ohm
Drain-Source On-Voltage (VGS = 10 V, ID = 5.5 Adc)				VDS(on)	(Vgs-10)	906 2.2 10	Vdc
Forward Transconductance (Vps = 5.0 V, Ip = 3.5 Adc)				9fs V	2.5 V) s	7.5	mhos
DYNAMIC CHARACTERIST	rics				ncs	ARACTERIS	NAME OF
Input Capacitance		Pies		Ciss	350	900	оваерБис
Output Capacitance	50	Coss	$(V_{DS} = 25 \text{ V}, V_{GS} = 0,$ f = 1.0 MHz)	Coss	100	450	coul Cape
Reverse Transfer Capacita	nce 05	Cras	1 - 1.0 Mile/same sa	C _{rss}	40 april	150	iert i sjev
SWITCHING CHARACTER	STICS*				*sorrer	CHARACTER	VITCHING
Turn-On Delay Time		(ap)b)		td(on)	_	30	no ns
Rise Time		t _f	(V _{DD} = 77 V, I _D = 3.5 A,	(V) t _r	_	50	BOWT 88
Turn-Off Delay Time		fitoin)	Rgen = 50 ohms)	td(off)	_	50	ed ito-m
Fall Time		33		tf		40	nmi I
SOURCE-DRAIN DIODE CI	HARACTERIS	STICS*		TICS*	HARACTERIS	a adolo MA	RO-EDRU
7.4 Vdo	0.7	oaV.		V _{SD}	0.7	1.4	Vdc
Forward Turn-On Time		no ²	(Is = Rated ID(on), based = all	ton	_	Negligible	noT Lins
Reverse Recovery Time		337	V _{GS} = 0)	t _{rr}	450 (Typ)	ergi T- yuavo	ns

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

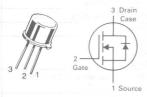
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	aby 400	aas Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	400	oos Vdc
Gate-Source Voltage	VGS	obV ± 20	Vdc
Drain Current Continuous Pulsed	I _D	3.0 14	Adc a.a ss
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	25 20 W 20	Watts W/°C
Operating and Storage Temperature Range	T _J , T _{stg}	-55 to 150	O'55 to 1

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	5.0	0.8 °C/W
Maximum Lead Temperature 1.6 mm from Case for 10 s	TL	300	000 °C

2N6800

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.) were tide assistant.

	nill Cha	racteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS							44	n apiece in
Drain-Source Breakdown	Voltage (VGS	= 0, I _D =	0.25 mA)	6Am 83	V(BR)DSS	400	4	Vdc
Zero Gate Voltage Drain (V _{DS} = Rated V _{DSS} , V _{DS} = 0.8 Rated V _{DS}	V _{GS} = 0)	2201 J = 125°C)			DSS (Dres)	nen 13 - 3) Ve g - 0.	250 1000	μAdc
Gate-Body Leakage Curr	ent, Forward (/GS = 20 V	'dc, V _{DS} = 0)	(vps = 0)	IGSSF	r Es m verid i	100	nAdc
Gate-Body Leakage Curr	ent, Reverse (\	$I_{GS} = -20$	$Vdc, V_{DS} = 0)$	da Vos = 0	IGSSR	Lazio na ffi,	- 100	nAdc
ON CHARACTERISTICS*								
Gate Threshold Voltage	$(V_{DS} = V_{GS},$	D = 0.5 m/	A)		VGS(th)	2.0	4.0	Vdc
Static Drain-Source On-F (V _{GS} = 10 Vdc, I _D =			T _A = 125°C	TA = 26°C TA = 125°C	rDS(on)	e s de stata 1 de stata	1.0	Ohm
Drain-Source On-Voltage (V _{GS} = 10 V, I _D = 3.0 Adc)			VDS(on)	/ 01 -3v	3.0	Vdc		
Forward Transconductar	nce (V _{DS} = 5.0	V, ID = 2.0	Adc)	(ab)	9fs 0	2.0	6.0	mhos
DYNAMIC CHARACTERIS	STICS					103		
Input Capacitance	350	Ciss			Ciss	350	900	pF
Output Capacitance	1.00	Coss	$(V_{DS} = 25 \text{ V}, V_{GS} = 0)$ f = 1.0 MHz)		Coss	50	300	
Reverse Transfer Capaci	tance 0	Cres	1 - 1.0 WH12/		C _{rss}	20	80	
SWITCHING CHARACTE	RISTICS*					150113	Me Jane	MED IN
Turn-On Delay Time		(no)b ¹			td(on)	_	30	ns
Rise Time	-	12 ($V_{DD} \approx 176 \text{ V, I}_{D} = 2.0$	Α,	y t _r	_	35	
Turn-Off Delay Time		(fic)b)	R _{gen} = 50 ohms)	R _{qen} = 50	td(off)	_	55	
Fall Time 04		31			tf	_	35	grant To C
SOURCE-DRAIN DIODE	CHARACTERIS	TICS*			rics	PHACTERS	10 200 1	C JUNEAU
		gaV			V _{SD}	0.7	1.4	Vdc
Forward Turn-On Time	_	not	(Is = Rated ID(on),	ils - Pated	ton	_	Negligible	ns
Reverse Recovery Time		yet.	V _{GS} = 0)	- 20V	t _{rr}		600	ns

^{*}Pulse Test: Pulse Width \leq 300 $\mu\text{s},$ Duty Cycle \leq 2.0%.

2N7000

MAXIMUM RATINGS

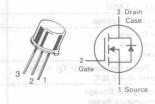
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	500	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	500	Vdc
Gate-Source Voltage	VGS	± 20	Vdc
Drain Current Continuous Pulsed	I _D		Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	25 0.2	Watts W/°C
Operating and Storage Temperature Range	T _J , T _{stg}	-55 to 150	°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	5.0	°C/W
Maximum Lead Temperature	TL	300	°C

2N6802

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR N-CHANNEL — ENHANCEMENT

С	haracteristi	c Chelon askaranio santi	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	toquive		(HERMODERE)			
Drain-Source Breakdown Voltage (V	GS = 0, ID	= 0.25 mA)	V(BR)DSS	500	SURTERBUTOR	Vdc
Zero-Gate Voltage Drain Current $(V_{DS} = Rated\ V_{DSS},\ V_{GS} = 0)$ $(V_{DS} = 0.8\ Rated\ V_{DSS},\ V_{GS} = 0.8$), T _J = 125°		IDSS	Vullege Current	250 1000	μAdc
Gate-Body Leakage Current, Forward	d (VGS = 20	0 Vdc, V _{DS} = 0)	IGSSF	961 - T. T.	100	nAdc
Gate-Body Leakage Current, Reverse	(VGS = -	20 Vdc, V _{DS} = 0)	IGSSR	nonana ma	-100	nAdc
ON CHARACTERISTICS*	1000			(0 =	agV abV at	Wase =
Gate Threshold Voltage (VDS = VGS	$_{S}$, $I_{D} = 0.5$	mA)	V _{GS(th)}	2.0	80114.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 1.5 Adc)	Vesten	T _A = 125°C	rDS(on)	-tam	3.5	Ohms
Drain-Source On-Voltage (V _{GS} = 10 V, I _D = 2.5 Adc)		V _{DS(on)}	earles estate	3.75	Vdc	
Forward Transconductance (V _{DS} = 5.0 V, I _D = 1.5 Adc)		9fs	1.5	4.5	mhos	
DYNAMIC CHARACTERISTICS			10.001	- 31 14 616	di mariti	69.11
Input Capacitance	no BCI.		Ciss	350	900	pF
Output Capacitance		$(V_{DS} = 25 \text{ V}, V_{GS} = 0,$ f = 1.0 MHz)	Coss	25	200	
Reverse Transfer Capacitance	(note)	1 – 1.0 MHZ	C _{rss}	15	103160	
SWITCHING CHARACTERISTICS*				(V U)	= 20 v. v 0.E	= bow
Turn-On Delay Time	前星		t _{d(on)}	Jan 1	30	ns
Rise Time		$(V_{DD} \approx 225 \text{ V}, I_{D} = 1.5 \text{ V},$	t _r	Ports	30	
Turn-Off Delay Time	aai7	R _{gen} = 50 ohms)	td(off)		55	
Fall Time	3814		() t _f	_	30	
SOURCE-DRAIN DIODE CHARACTER	ISTICS*	f = 1:0 MH2)		2000	anaday Pagasi	T. oversal
			V _{SD}	0.7	1.4	Vdc
Forward Turn-On Time		(Is = Rated Ip,	ton		Negligible	ns
Reverse Recovery Time	00;	$V_{GS} = 0$	t _{rr}	800	_	ns

^{*}Pulse Test: Pulse Width \leq 300 μs , Duty Cycle \leq 2.0%.

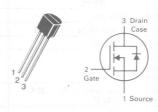
Rating Rating	Symbol	Value	Unit
Drain-Source Voltage	VDSS	60	Vdc
Drain-Gate Voltage $(R_{GS} = 1 M\Omega)$	VDGR	60 ₀	Vdc
Gate-Source Voltage	VGS	± 40	Vdc
Drain Current Continuous Pulsed	I _D	200 500	mAdc
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	400 3.2	mW mW/°C
Operating and Storage Temperature Range	TJ, T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Ambient	$R_{\theta JA}$	312.5	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/16" from case for 10 seconds	TL	300	00€ 300€

2N7000

CASE 29-04, STYLE 7 TO-92 (TO-226AA)



TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

Cha	racteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	mana pana dili	(April 20)	Description of	M see 1 2 v		7.7
Drain-Source Breakdown Voltage $(V_{GS} = 0, I_D = 10 \mu A)$	ssa _l	Dall as	V _{(BR)DSS}	60	Hay a j	Vdc
Zero Gate Voltage Drain Current (VDS = 48 V, VGS = $^{\circ}$ 0) (VDS = 48 V, VGS = 0, TJ = 125 $^{\circ}$ C	18851	c, VQS = 0)	fordIDSS (T	1 = 227 23 1 = 227 23	1.0 1.0	μAdc mA
Gate-Body Leakage Current, Forward (VGSF = 15 Vdc, VDS = 0)	uses ₁	10 - SQ _A (pp	IGSSF	is tiver, his	10	nAdc
ON CHARACTERISTICS*	VGS(th)		(Am 20 = 01 g	VDS I VG		10 1 5 5 1
Gate Threshold Voltage (VDS = VGS, ID = 1.0 mA)	[no)801	тд – 126°С	V _{GS(th)}	0.8	3.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 0.5 Adc) (VGS = 10 Vdc, ID = 0.5 V, TC = 13 \times	(no)2GV	a) Adej	103(011)	5 <u>0,</u> e.c. n = 50, e.c.	5.0 9.0	Ohm
Drain-Source On-Voltage (V _{GS} = 10 V, I _D = 0.5 Adc) (V _{GS} = 4.5 V, I _D = 75 mA)	Ciss	ns - 25 V. Ves - 0.	VDS(on)	-	2.5 0.4	Vdc
On-State Drain Current (VGS = 4.5 V, VDS = 10 V)	Sal		l _{d(on)}	75	334 -	mA
Forward Transconductance (V _{DS} = 10 V, I _D = 200 mA)	(ao)b‡		9fs	100		μmhos
DYNAMIC CHARACTERISTICS		og - 225 V, Ip = 1.6 V.	101			
Input Capacitance	(ftolb)	temmage - halps	Ciss		60	pF
Output Capacitance		$S = 25 \text{ V}, \text{ V}_{GS} = 0$ f = 1.0 MHz	Coss		25	HP H
Reverse Transfer Capacitance		1 - 1.0 WITE	C _{rss}	HST DANAPL	5.0	1 198 Lds
SWITCHING CHARACTERISTICS*	ggV					
Turn-On Delay Time	(VDD =	= 15 V, I _D = 600 mA	ton		10	ns
Turn-Off Delay Time		5 ohms, R _L = 25 ohms)	toff		10	. Prince

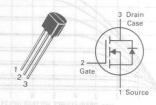
⁽¹⁾ Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MAXIMOM HATINGO			
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	60	Vdc
Drain-Gate Voltage (RGS = 1 M Ω)	VDGR	60	Vdc
Gate-Source Voltage	VGS	± 40	Vdc
Drain Current Continuous Pulsed	I _D	150 1000	mAdc
Total Power Dissipation @ T _A = 25°C Derate above 25°C	PD	400 3.2	mW mW/°C
Operating and Storage 100 and 120 TAD 25 TEMPERATURE Range		-55 to +150	°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Ambient	$R_{\theta JA}$	312.5	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/16" from case for 10 seconds	TL	300	°C

CASE 29-04, STYLE 22 TO-92 (TO-226AA)

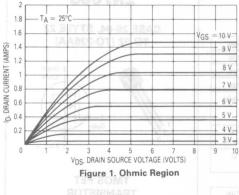


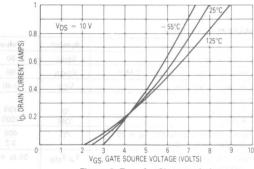
TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

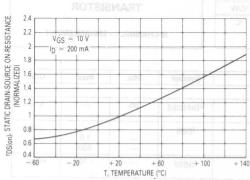
Cha	racteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					- 4
Drain-Source Breakdown Voltage $(V_{GS} = 0, I_D = 100 \mu A)$	85.0 (5)	V _{(BR)DSS}	60		Vdc
Zero Gate Voltage Drain Current (V _{DS} = 50 V, V _{GS} = 0) (V _{DS} = 50 V, V _{GS} = 0, T _J = 125°C)	8.0 E	IDSS		1.0 500	μAdc
Gate-Body Leakage Current, Forward (VGSF = 30 Vdc, VDS = 0)	- 20 - 20 - 20 - 20 - 20 - 20 - 20 - 20	IGSSF	+ 20 — + TEMPERATURE	-100	nAdc
ON CHARACTERISTICS*	unce Figure & Temperat	Static Drain-So			
Gate Threshold Voltage $(V_{DS} = V_{GS}, I_{D} = 250 \mu A)$		V _{GS(th)}	1.0	2.5	Vdc
Static Drain-Source On-Resistance (VGS = 5.0 Vdc, ID = 50 Adc) (VGS = 10 Vdc, ID = 500 mAdc, TC	= 125°C)	rDS(on)	_	7.5 13.5	Ohm
Drain-Source On-Voltage (V _{GS} = 5.0 V, I _D = 50 mA) (V _{GS} = 10 V, I _D = 500 mA)		VDS(on)	_	1.5 3.75	Vdc
On-State Drain Current $(V_{GS} = 10 \text{ V}, V_{DS} \ge 2.0 \text{ V}_{D(on)})$		I _{D(on)}	500	_	mA
Forward Transconductance (V _{DS} ≥ 2.0 V _{DS} (on), I _D = 200 mA)		9fs	80	_	μmhos
DYNAMIC CHARACTERISTICS					
Input Capacitance		Ciss	_	50	pF
Output Capacitance	$(V_{DS} = 25 \text{ V}, V_{GS} = 0)$ f = 1.0 MHz)	Coss		25	
Reverse Transfer Capacitance		C _{rss}	_	5.0	
SWITCHING CHARACTERISTICS*					
Turn-On Delay Time	(V _{DD} = 30 V, I _D = 200 mA	ton	_	20	ns
Turn-Off Delay Time	$R_{gen} = 25 \text{ ohms}, R_L = 150 \text{ ohms})$	toff	_	20	

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.









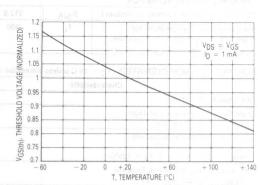
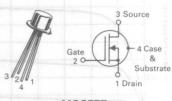


Figure 3. Temperature versus Static Drain-Source

Figure 4. Temperature versus Gate Threshold Voltage

3N128

CASE 20-03, STYLE 7 TO-72 (TO-206AF)



MOSFET

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

WAXINOW HATINGS			
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	+ 20	Vdc
Drain-Gate Voltage	V _{DG}	+ 20	Vdc
Gate-Source Voltage	VGS	± 10	Vdc
Drain Current	ID	50	mAdc
Total Device Dissipation @ T _A = 25°C and Derate above 25°C	PD	330 2.2	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +175	°C

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Gate-Source Breakdown Voltage(1) (IG = -10 µAdc, VDS = 0)	V _{(BR)DSS}	- 50	_	Vdc
Gate Reverse Current $(V_{GS} = -8.0 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -8.0 \text{ Vdc}, V_{DS} = 0, T_{A} = 125^{\circ}\text{C})$	IGSS		0.05 5.0	nAdc
Gate Source Cutoff Voltage (V _{DS} = 15 Vdc, I _D = 50 µAdc)	VGS(off)	-0.5	-8.0	Vdc
ON CHARACTERISTICS			1	
Zero-Gate-Voltage Drain Current(2) (V _{DS} = 15 Vdc, V _{GS} = 0)	IDSS	5.0	25	mAdc
SMALL-SIGNAL CHARACTERISTICS				
Forward Transfer Admittance (VDS = 15 Vdc, I _D = 5.0 mAdc, f = 1.0 kHz)	Y _{fs}	5000	12,000	μmhos
Input Admittance (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 200 MHz)	Re(yis)	_	800	μmhos
Output Conductance (VDS = 15 Vdc, I _D = 5.0 mAdc, f = 200 MHz)	Re(yos)	_	500	μmhos
Forward Transconductance (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 200 MHz)	Re(yfs)	5000	-	μmhos
Input Capacitance (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 1.0 MHz) (C4 - 3.3 HUD13 (TH3HC)	Ciss OMMOD (avv) BO	KATTIMGA	7.0 TURVII — 8 3 A	pF DE M
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 1.0 MHz)	C _{rss}	0.05	0.35	pF
FUNCTIONAL CHARACTERISTICS				
Noise Figure (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 200 MHz)	NF		5.0	dB
Power Gain (V _{DS} = 15 Vdc, I _D = 5.0 mAdc, f = 200 MHz)	PG	13.5	23	dB

- (1) Caution Destructive Test, can damage gate oxide beyond operation.
- (2) Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2.0%.



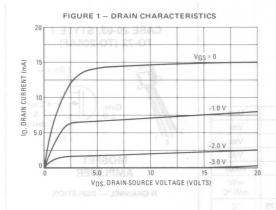
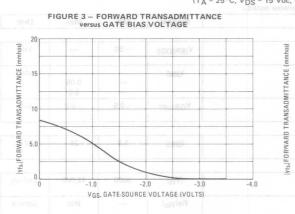
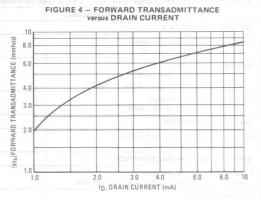


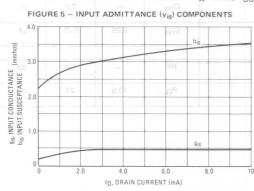
FIGURE 2 – TRANSFER CHARACTERISTICS 20 VDS = 15 Vdc VDS

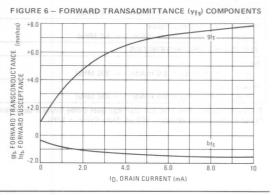
TYPICAL 1 kHz DRAIN CHARACTERISTICS (T_A = 25°C, V_{DS} = 15 Vdc, f = 1.0 kHz)





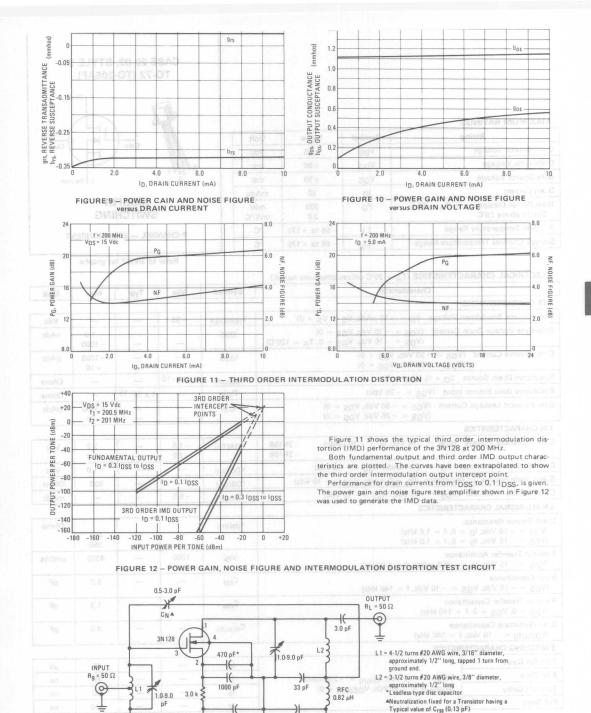
TYPICAL 200 MHz COMMON-SOURCE ADMITTANCE CHARACTERISTICS (TA = 25° C, VDS = 15° Vdc, f = 200° MHz)





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





1000 pF MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

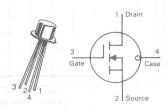
0 +16 V

1000 pF

-14 V 6

3N155 3N156

CASE 20-03, STYLE 2 TO-72 (TO-206AF)



MOSFET SWITCHING

P-CHANNEL — ENHANCEMENT

Refer to 3N157 for graphs.

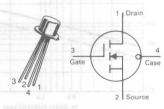
MAXIMUM RATINGS

Rating	Symbol	Value	Unit	
Drain-Source Voltage	V _{DS}	± 35	Vdc	
Drain-Gate Voltage	V _{DG}	± 50	Vdc	
Gate-Source Voltage	VGS	± 50	Vdc	
Drain Current	ID	30	mAdc	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 2.0	mW mW/°C	
Junction Temperature Range	TJ	-65 to +175	°C	
Storage Channel Temperature Range	T _{stg}	-65 to +175	°C	

8 1	Characteristic	10 - 11	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	3				C. COASHOLI		1 3
Drain-Source Breakdown Voltag	ge ($I_D = -10 \mu Adc$, $V_G = V_S =$	0) = 03	V(BR)DSX	-35	1-1	-	Vdc
Zero-Gate-Voltage Drain Currer	nt $(V_{DS} = -10 \text{ Vdc}, V_{GS} = 0)$ $(V_{DS} = -10 \text{ Vdc}, V_{GS} = 0, T_A)$	Δ = 125°C)	IDSS		=	- 1.0 - 1000	nAdc
Gate Reverse Current (VGS =	+50 Vdc, V _{DS} = 0) +25 Vdc, V _{DS} = 0)	01	IGSS	63 <u>-</u> Am 1 <u>-13</u> 11102	u≠ <u> </u>	+ 1000 + 10	pAdc
Resistance Drain Source (ID =	= 0, V _{GS} = 0) на монта годона	ORDER WITE	rDS(off)	1 x 10+10		_	Ohms
Resistance Gate Source Input	$(V_{GS} = -25 \text{ Vdc})$		RGS		1 x 10+16	-	Ohms
Gate Forward Leakage Current	$(V_{GS} = -50 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -25 \text{ Vdc}, V_{DS} = 0)$		G(f)	141	- 1918 - 1918	- 1000 - 10	pAdc
ON CHARACTERISTICS			11 1000				- Ē
Gate Threshold Voltage (V _{DS}	$= -10 \text{ Vdc}, I_D = -10 \mu \text{Adc})$	3N155 3N156	V _{GS(Th)}	- 1.5 - 3.0	MATER BOTTON	-3.2 -5.0	Vdc
Drain-Source On-Voltage (ID	$= -2.0 \text{ mAdc}, V_{GS} = -10 \text{ Vdc})$	(40) 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	V _{DS(on)}	-	\$201 at 32.0 l	-1.0	Vdc
Static Drain-Source On Resista	nce $(I_D = 0 \text{ mAdc}, V_{GS} = -10 \text{ N})$	/dc)	rDS(on)	SS.0 111 1 = 0,		600	Ohms
On-State Drain Current (VDS	$= -15 \text{ Vdc}, \text{ V}_{GS} = -10 \text{ Vdc})$	220101	ID(on)	-5.0		_	mAdc
SMALL-SIGNAL CHARACTERIS	STICS		1	TOPEL DO THE	изака сас		
Drain-Source Resistance $ (V_{GS} = -10 \text{ Vdc}, I_{D} = 0, f = $			rds(on)	18 10 11 11 11 11 11 11 11 11 11 11 11 11	(d - 'T <u>C</u> 1 - 1	400 350	Ohms
Forward Transfer Admittance (VDS = -15 Vdc, ID = -2.0) mAdc, f = 1.0 kHz)	GURE AND II	Yfs 13 Batota Mila	1000	S) PRODE	4000	μmhos
Input Capacitance (VDS = -15 Vdc, VGS = -	10 Vdc, f = 140 kHz)		C _{iss}	90.53	10	5.0	pF
Reverse Transfer Capacitance (V _{DS} = 0, V _{GS} = 0, f = 140 kHz)					_	1.3	pF
Drain-Substrate Capacitance (VD(SUB) = -10 Vdc, f = 140 kHz)				- Total V 1851	_	4.0	pF
SWITCHING CHARACTERISTIC	S publisher Sit-Eveld (25)	7	290000				
Turn-On Delay	"SV" / Proposition (SV VIZ")	75 0.000.51	td	2 = 2 =		45	μs
Rise Time (VD	$I_D = -10 \text{ Vdc}, I_{D(on)} = -2.0 \text{ mA}$	dc,	tr	_		65	ns
Turn-Off Delay VGS	$S(on) = -10 \text{ Vdc}, V_{GS(off)} = 0)$		t _S	Sant po		60	ns
Fall Time a getiven redelene T a ref t	benil melanikanyaka		tf	_ 1		100	ns

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CASE 20-03, STYLE 2 TO-72 (TO-206AF)



MOSFET AMPLIFIER AND SWITCHING

P-CHANNEL — ENHANCEMENT

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage*	V _{DS}	± 35	Vdc
Drain-Gate Voltage*	V _{DG}	± 50	Vdc
Gate-Source Voltage*	VGS	± 50	Vdc
Drain Current*	ID	1.0 30	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C*	PD	300 1.7	mW mW/°C
Junction Temperature Range*	TJ	-65 to +175	°C
Storage Channel Temperature Range*	T _{stg}	-65 to +175	°C

*JEDEC Registered Limits

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage $(I_D = -10 \mu Adc, V_G = V_S = 0)$	V(BR)DSX	-35			Vdc
Zero-Gate-Voltage Drain Current $(V_{DS} = -15 \text{ Vdc}, V_{GS} = 0)$ $(V_{DS} = -35 \text{ Vdc}, V_{GS} = 0)$	IDSS		= 2	- 1.0 - 10	nAdc μAdc
Gate Reverse Current* $(V_{GS} = +25 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = +50 \text{ Vdc}, V_{DS} = 0)$	IGSS	-	-	+ 10 + 10	pAdc nAdc
Input Resistance (VGS = -25 Vdc)	RGS	-	1 x 10+12		Ohms
Gate Source Voltage* $ (V_{DS} = -15 \text{ Vdc, I}_{D} = -0.5 \text{ mAdc}) \qquad \qquad 3N1 $ $ 3N1 $		- 1.5 - 3.0	V 21 -	-1 - 5.5 - 7.0	Vdc
Gate Forward Current* $(V_{GS} = -25 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -50 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -25 \text{ Vdc}, V_{DS} = 0, T_{A} = +55^{\circ}\text{C})$ $(V_{GS} = -50 \text{ Vdc}, V_{DS} = 0, T_{A} = +55^{\circ}\text{C})$	IG(f)	to	ZS Z	-10 -1.0 -10 -1.0	pAdc nAdc nAdc μAdc
ON CHARACTERISTICS					
Gate Threshold Voltage* $ (V_{DS} = -15 \text{ Vdc}, I_{D} = -10 \ \mu\text{Adc}) $ 3N1 3N1		- 1.5 - 3.0	=	-3.2 -5.0	Vdc
On-State Drain Current* (V _{DS} = -15 Vdc, V _{GS} = -10 Vdc)	ID(on)	-5.0	_	_	mAdc
SMALL-SIGNAL CHARACTERISTICS	min sim sons	2001100			
Forward Transfer Admittance* $(V_{DS} = -15 \text{ Vdc}, I_{D} = -2.0 \text{ mAdc}, f = 1.0 \text{ kHz})$	Vfs	1000	MACIO M	4000	μmhos
Output Admittance* ($V_{DS} = -15 \text{ Vdc}$, $I_{D} = -2.0 \text{ mAdc}$, $f = 1.0 \text{ kHz}$)	Yos	11-1	1 +	60	μmhos
Input Capacitance* $(V_{DS} = -15 \text{ Vdc}, V_{GS} = 0, f = 140 \text{ kHz})$	C _{iss}	-/		5.0	pF
Reverse Transfer Capacitance* (VDS = -15 Vdc, VGS = 0, f = 140 kHz)	C _{rss}	1	1/71	1.3	pF
Drain-Substrate Capacitance (VD(SUB) = −10 Vdc, f = 140 kHz)	C _{d(sub)}		XH	4.0	pF
Noise Voltage (Rg = 0, BW = 1.0 Hz,	en		11/	1	NV/√H
$V_{DS} = -15 \text{ Vdc}, I_D = -2.0 \text{ mAdc}, f = 100 \text{ Hz})$ $(R_S = 0, BW = 1.0 \text{ Hz},$	-2.0 mA -1.0 mA -0.5 mA		300	4	1. 3
$V_{DS} = -15 \text{ Vdc}, I_{D} = -2.0 \text{ mAdc}, f = 1.0 \text{ kHz})$	85- 81- 81- 81-	\$1- gl-	120	500	n

*JEDEC Registered Limits

6

FIGURE 1 - FORWARD TRANSCONDUCTANCE

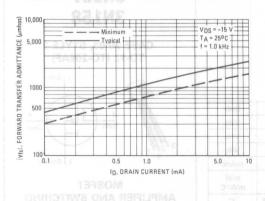


FIGURE 2 - OUTPUT TRANSCONDUCTANCE

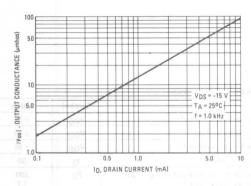


FIGURE 3 - FORWARD TRANSCONDUCTANCE

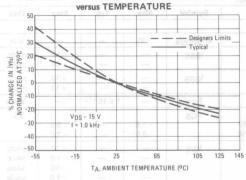


FIGURE 4 - BIAS CURVE

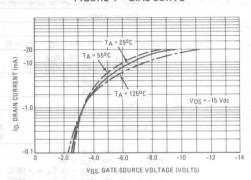


FIGURE 5 - "ON" DRAIN-SOURCE VOLTAGE

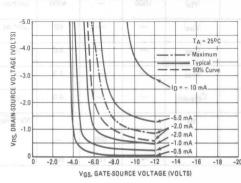
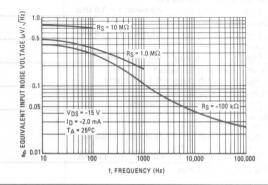


FIGURE 6 - EQUIVALENT INPUT NOISE VOLTAGE



VGS = -10 V

Vns

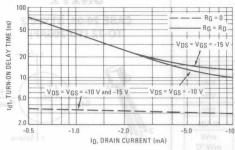
(us)

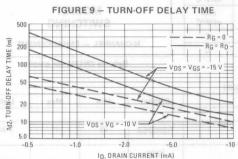
R 30

t.

RG = RD







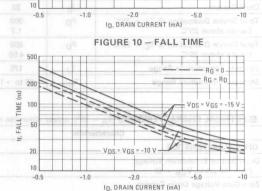


FIGURE 11 - SWITCHING CIRCUIT and WAVEFORMS

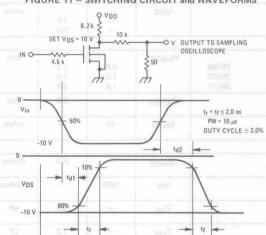
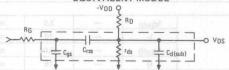


FIGURE 12 – SWITCHING CIRCUIT with MOSFET EQUIVALENT MODEL



The switching characteristics shown above were measured in a test circuit similar to Figure 11. At the beginning of the switching interval, the gate voltage is at ground and the gate source capacitance ($C_{gs} \cdot C_{rss} \cdot C_{rss}$) has no charge. The drain voltage is at V_{DD} and thus the feedback capacitance (C_{rss}) is charged to V_{DD} . Similarly, the drain substrate capacitance ($C_{d(sub)}$) is charged to V_{DD} since the substrate and source are connected to ground.

During the turn-on interval C_{gs} is charged to V_{GS} (the input voltage) through R_G (generator impedance) (Figure 12). C_{rss} must be discharged to $V_{GS} \cdot V_{D(on)}$ through R_G and the parallel combination of the load resistor (R_D) and the channel resistance (r_{ds}). In addition, $C_{d(sub)}$ is discharged to a low value ($V_{D(on)}$) through R_D in parallel with r_{ds} . During turn-off this charge flow is reversed.

Predicting turn-on time proves to be somewhat difficult since the channel resistance (r_{ds}) is a function of the gate source voltage (V_{GS}) . As C_{gs} becomes charged V_{GS} is approaching V_{in} and r_{ds} decreases (see Figure 5) and since C_{rss} and $C_{d(sub)}$ are charged through r_{ds} . turn-on time is quite non-linear.

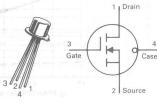
If the charging time of C_{GS} is short compared to that of C_{TSS} and $C_{d(Sub)}$, then r_{dS} (which is in parallel with R_D) will be low compared to R_D during the switching interval and will largely determine the turn-on time. On the other hand, during turn-off r_{dS} will be almost an open circuit requiring C_{TSS} and $C_{d(Sub)}$ to be charged through R_D and resulting in a turn-off time that is long compared to the turn-on time. This is especially noticeable for the curves where $R_G \cdot 0$ and C_{GS} is charged through the pulse generator impedance only.

The switching curves shown with R_G • R_D simulate the switching behavior of cascaded stages where the driving source impedance is normally the same as the load impedance. The set of curves with R_G • 0 simulates a low source impedance drive such as might occur in complementary logic circuits.

CHING CHARACTERISTICS

3N169 3N170 3N171

CASE 20-03, STYLE 2 TO-72 (TO-206AF)



MOSFET SWITCHING

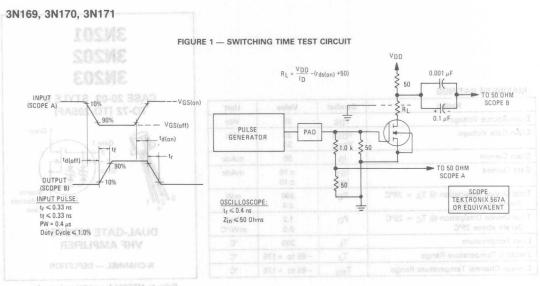
N-CHANNEL — ENHANCEMENT

Refer to 2N4351 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG}	±35	Vdc
Gate-Source Voltage	VGS	± 35	Vdc
Drain Current	ID	30	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.7	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	800 4.56	mW mW/°C
Junction Temperature Range	TJ	175	°C
Storage Temperature Range	T _{stg}	-65 to +175	°C

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS		-t-Y			
Drain-Source Breakdown Voltage (I _D = 10 μAdc, V _{GS} = 0)		V _{(BR)DSX}	25		Vdc
Zero-Gate-Voltage Drain Current (V _{DS} = 10 Vdc, V _{GS} = 0) (V _{DS} = 10 Vdc, V _{GS} = 0, T _A = 125°C)	WAVEFORMS	DSS THURSE	maro <u>c</u> i Omn o tewa	10	nAdc μAdc
Gate Reverse Current ($V_{GS} = -35$ Vdc, $V_{DS} = 0$) ($V_{GS} = -35$ Vdc, $V_{DS} = 0$, $V_{AB} = 125^{\circ}$ C)		IGSS	00V 9	10 100	pAdc
ON CHARACTERISTICS	PUT TO SAMPLING			1	
Gate Threshold Voltage and any vholimizing of the prishold (V _{DS} = 10 Vdc, I _D = 10 μAdc) is gg/V or traps to a (graph).	3N169 3N170 3N171	VGS(Th)	0.5 1.0 1.5	1.5 2.0 3.0	Vdc
Drain-Source On-Voltage (ID = 10 mAdc, VGS = 10 Vdc)	an D. S. et al. et al.	V _{DS} (on)		2.0	Vdc
On-State Drain Current (V _{GS} = 10 Vdc, V _{DS} = 10 Vdc)	PW = 10,us OUTY GYCLE = 2:0%	I _D (on)	10	7	mAdc
SMALL-SIGNAL CHARACTERISTICS earlieves at well agreed aint					
Drain-Source Resistance ($V_{GS}=10~V_{dc}, I_{D}=0, f=1.0~kHz$)	7	rds(on)		200	Ohms
Forward Transfer Admittance applications as a second public (VDS = 10 Vdc, ID = 2.0 mAdc, f = 1.0 kHz) and personal area.		Yfs	1000	/ I	μmhos
Input Capacitance (Vps = 10 Vdc, Vgs = 0, f = 1.0 MHz)		C _{iss}		5.0	pF
Reverse Transfer Capacitance (V _{DS} = 0, V _{GS} = 0, f = 1.0 MHz)	tro 13	C _{rss}		1.3	pF
Drain-Substrate Capacitance use line (If deposit begreath ad of (VD(SUB) = 10 Vdc, f = 1.0 MHz) and of benegrood good at		C _{d(sub)}	SWITCHING	5.0	pF
SWITCHING CHARACTERISTICS			P anv-		
Turn-On Delay Time $(V_{DD} = 10 \text{ Vdc}, I_{D(on)} = 10 \text{ mAdc},$		t _{d(on)}	} —	3.0	ns
Rise Time $V_{GS(on)} = 10 \text{ Vdc}, V_{GS(off)} = 0,$		t _r		10	ns
Turn-Off Delay Time RG' = 50 Ohms)		t _d (off)	} <u>-</u> _0	3.0	ns
Fall Time See Figure 1		tf		15	ns



Rules to MFF201 for additional graphs.

LECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)			
Citaracteristic			
se 2-Source Breakdown Vollage(1) 8cp = ±10 mAdc, Vgrg = Vgg = 0)			
10 2 1,59kage Current VG2S = ±6.0 Vdc, VG1S = VDS = 0 VG2S = -5.0 Vdc, VG1S = VDS = 0, TA = 150°C)			

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG1} V _{DG2}	30 Ad 30	Vdc
Drain Current	ID	50	mAdc
Gate Current	I _{G1}	± 10 ± 10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	360 2.4	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 8.0	Watt mW/°C
Lead Temperature	TL	300	°C
Junction Temperature Range	TJ	-65 to +175	°C
Storage Channel Temperature Range	T _{stg}	-65 to +175	°C

CASE 20-03, STYLE 9 TO-72 (TO-206AF) Gate 1 Source Substrate Case DUAL-GATE MOSFET VHF AMPLIFIER N-CHANNEL — DEPLETION

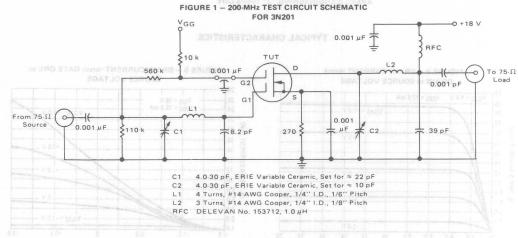
Refer to MPF201 for additional graphs.

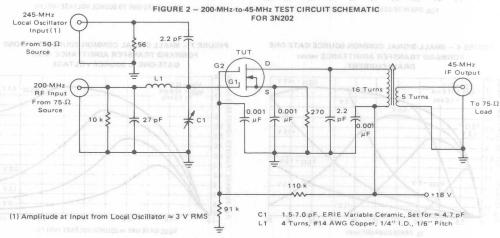
Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						•
Drain-Source Breakdown Voltage (I _D = 10 μAdc, V _S = 0, V _{G1S} = V _{G2S} = -5.0 Vdc)		V(BR)DSX	25	_	_	Vdc
Gate 1-Source Breakdown Voltage(1) $(I_{G1} = \pm 10 \text{ mAdc}, V_{G2S} = V_{DS} = 0)$		V _(BR) G1SO	± 6.0	± 12	±30	Vdc
Gate 2-Source Breakdown Voltage(1) $(I_{G2} = \pm 10 \text{ mAdc}, V_{G1S} = V_{DS} = 0)$		V _(BR) G2SO	± 6.0	± 12	±30	Vdc
Gate 1 Leakage Current $(V_{G1S} = \pm 5.0 \text{ Vdc}, V_{G2S} = V_{DS} = 0)$ $(V_{G1S} = -5.0 \text{ Vdc}, V_{G2S} = V_{DS} = 0, T_A = 150^{\circ}C)$		I _{G1SS}	_	± .040 —	± 10 - 10	nAdc μAdc
Gate 2 Leakage Current $(V_{G2S} = \pm 5.0 \text{ Vdc}, V_{G1S} = V_{DS} = 0)$ $(V_{G2S} = -5.0 \text{ Vdc}, V_{G1S} = V_{DS} = 0, T_{A} = 150^{\circ}\text{C})$		I _{G2SS}	_	±.050 —	± 10 - 10	nAdc μAdc
Gate 1 to Source Cutoff Voltage (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = 20 μ Adc)		VG1S(off)	-0.5	-1.5	-5.0	Vdc
Gate 2 to Source Cutoff Voltage (V _{DS} = 15 Vdc, V _{G1S} = 0, I _D = 20 μ Adc)		VG2S(off)	-0.2	-1.4	- 5.0	Vdc
ON CHARACTERISTICS						
Zero-Gate-Voltage Drain Current(2) $(V_{DS} = 15 \text{ Vdc}, V_{G1S} = 0, V_{G2S} = 4.0 \text{ Vdc})$	3N201,3N202 3N203	IDSS	6.0 3.0	13 11	30 15	mAdc
SMALL-SIGNAL CHARACTERISTICS						
Forward Transfer Admittance(3) $(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, V_{G1S} = 0, f = 1.0 \text{ kHz})$	3N201,3N202 3N203	Y _{fs}	8.0 7.0	12.8 12.5	20 15	mmhos
Input Capacitance (VDS = 15 Vdc, V_{G2S} = 4.0 Vdc, I_D = I_{DSS} , f = 1.0 MHz)		C _{iss}	_	3.3	_	pF
Reverse Transfer Capacitance (VDS = 15 Vdc, V_{C2S} = 4.0 Vdc, I_D = 10 mAdc, f = 1.0 M	Hz)	C _{rss}	0.005	0.014	0.03	pF
Output Capacitance (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = IDSS, f = 1.0 MHz)		C _{oss}	_	1.7	-	pF
FUNCTIONAL CHARACTERISTICS						
Noise Figure ($V_{DD} = 18 \text{ Vdc}$, $V_{GG} = 7.0 \text{ Vdc}$, $f = 200 \text{ MHz}$) (Figure 1) ($V_{DD} = 18 \text{ Vdc}$, $V_{GG} = 6.0 \text{ Vdc}$, $f = 45 \text{ MHz}$) (Figure 3)	3N201 3N203	NF	=	1.8 5.3	4.5 6.0	dB

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

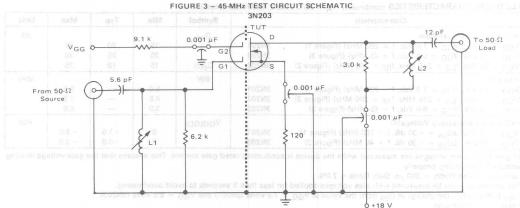
Characteristic	DOTAGE.	Symbol	Min	Тур	Max	Unit
Common Source Power Gain (VDD = 18 Vdc, VGG = 7.0 Vdc, f = 200 MHz) (Figure 1)	3N201	Gps	15	20	25	dB
(VDD = 18 Vdc, VGG = 6.0 Vdc, f = 45 MHz) (Figure 3)	3N203	28	20	25	30	
$(V_{DD} = 18 \text{ Vdc}, f_{LO} = 245 \text{ MHz}, f_{RF} = 200 \text{ MHz}) \text{ (Figure 2)}$	3N202	G _c (5)	15	19	25	
Bandwidth		BW		to a d		MHz
(V _{DD} = 18 Vdc, V _{GG} = 7.0 Vdc, f = 200 MHz) (Figure 1)	3N201		5.0	46-60	9.0	W15 -
(VDD = 18 Vdc, fLO = 245 MHz, fRF = 200 MHz) (Figure 2)	3N202		4.5	-	7.5	
$(V_{DD} = 18 \text{ Vdc}, V_{GG} = 6.0 \text{ Vdc}, f = 45 \text{ MHz}) \text{ (Figure 3)}$	3N203		3.0	_	6.0	
Gain Control Gate-Supply Voltage(4)		VGG(GC)				Vdc
$(V_{DD} = 18 \text{ Vdc}, \Delta G_{DS} = -30 \text{ dB}, f = 200 \text{ MHz}) \text{ (Figure 1)}$	3N201	11.3	0	-1.0	- 3.0	
$(V_{DD} = 18 \text{ Vdc}, \Delta G_{DS} = -30 \text{ dB}, f = 45 \text{ MHz}) \text{ (Figure 3)}$	3N203	47.03	0	-0.6	- 3.0	

- (1) All gate breakdown voltages are measured while the device is conducting rated gate current. This ensures that the gate-voltage limiting network is functioning properly.
- (2) Pulse Test: Pulse Width = 300 μ s, Duty Cycle \leq 2.0%.
- (3) This parameter must be measured with bias voltages applied for less than 5 seconds to avoid overheating.
- (4) ΔG_{ps} is defined as the change in G_{ps} from the value at $V_{GG} = 7.0$ volts (3N201) and $V_{GG} = 6.0$ volts (3N203).
- (5) Power Gain Conversion



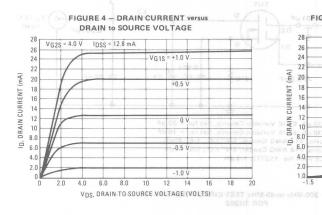






- 14 Turns, #30 AWG Copper, Close-Wound 7/32" OD form with ARNOLD ENGINEERING "J" Tuning Core
- 10 Turns, #30 AWG Copper, Close-Wound 7/32" OD form with ARNOLD ENGINEERING "J" Tuning Core

TYPICAL CHARACTERISTICS



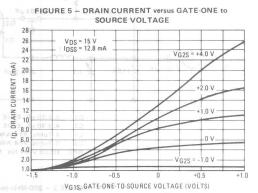


FIGURE 6 - SMALL-SIGNAL COMMON-SOURCE GATE-ONE FORWARD TRANSFER ADMITTANCE versus DRAIN CURRENT

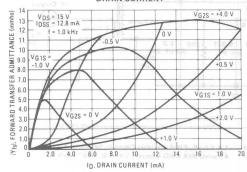


FIGURE 7 - SMALL-SIGNAL COMMON-SOURCE GATE-ONE FORWARD TRANSFER ADMITTANCE versus GATE-ONE to SOURCE VOLTAGE

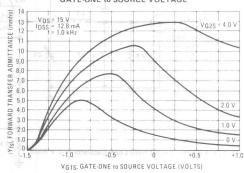
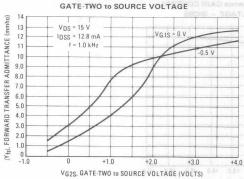
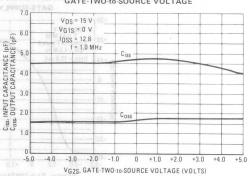


FIGURE 8 – SMALL-SIGNAL COMMON-SOURCE GATE-ONE FIGURE 9 – SMALL-SIGNAL COMMON-SOURCE GATE-ONE FORWARD TRANSFER ADMITTANCE versus



INPUT AND OUTPUT CAPACITANCE versus GATE-TWO-to-SOURCE VOLTAGE



TYPICAL CHARACTERISTICS

FIGURE 10 - COMMON-SOURCE POWER GAIN AND

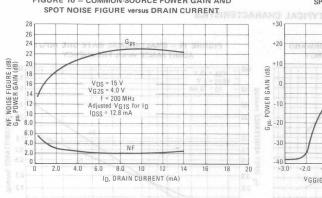


FIGURE 11 - COMMON-SOURCE POWER GAIN AND SPOT NOISE FIGURE versus GAIN CONTROL

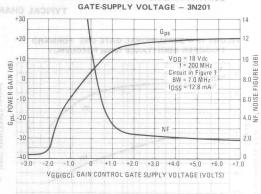


FIGURE 12 - COMMON-SOURCE POWER GAIN AS JAMES JAMES - TO SECONVERSION POWER GAIN versus

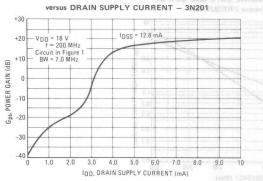


FIGURE 13 - SMALL-SIGNAL COMMON-SOURCE

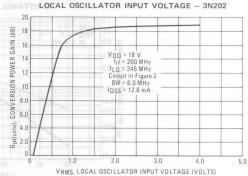
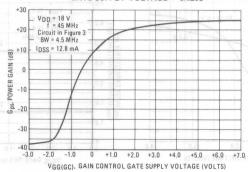


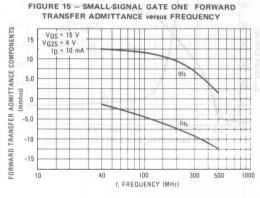
FIGURE 14 – SMALL-SIGNAL COMMON SOURCE
INSERTION POWER GAIN versus GAIN CONTROL
GATE-SUPPLY VOLTAGE – 3N203

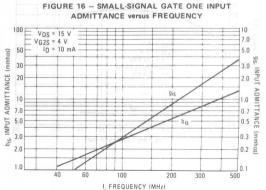


TYPICAL CHARACTERISTICS

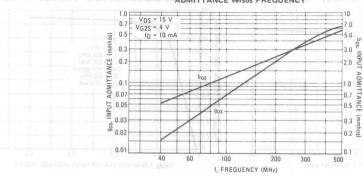
ONA MIAD REMOR SOURCE POWER GAIN AND SPOT NOISE FIGURE SHOULD REMOVE CONTROL TYPICAL CHARACTERISTICS UNIVERSE SHOULD READ AS SHOULD REMOVE SHOULD REMOVE SHOULD REMOVE THE REMOVER OF THE REMOVE THE REMOVER OF THE REMO







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MAXIMUM RATINGS				
Rating		Symbol	Value	Unit
Drain-Source Voltage	43	V _{DS}	25	Vdc
Drain-Gate Voltage		V _{DG}	30	Vdc
Drain Current	his insured the	ID	50	mA
Reverse Gate Current	T.	IG	- 10	mA
Forward Gate Current	Bentavo blove	IGF	10	mA
Total Device Dissipation @ Derate above 25°C	$T_A = 25^{\circ}C$	PD	360 2.4	mW mW/°C
Total Device Dissipation @ Derate above 25°C	$T_C = 25^{\circ}C$	PD	1.2 0.8	mW mW/°C
Lead Temperature		TL	300	°C
Operating and Storage Jun Temperature Range	ction	TJ, T _{stg}	- 65°C to + 175°C	°C



Symbol

	Characteristic
	OFF CHARACTERISTICS
CONTRACTOR OF THE PERSON	Drain-Source Breakdown Voltage (I _D = 10 μ A, V _{G1} = V _{G2} = -5.0 V)

Drain-Source Breakdown Voltage (ID = 10 μ A, VG1 = VG2 = -5.0 V)	V(BR)DSX	25	-	Vdc
Gate 1-Source Breakdown Voltage (I _{G1} = ±10 mA) Note 1	V _(BR) G1SO	±6	±30	Vdc
Gate 2-Source Breakdown Voltage (I _{G2} = ±10 mA) Note 1	V _(BR) G2SO	±6	±30	Vdc
Gate 1 Leakage Current $(V_{G1S} = \pm 5.0 \text{ V}, V_{G2S} = V_{DS} = 0)$	I _{G1SS}	_	± 10	nA
Gate 2 Leakage Current (VG2S = ±5.0 V, VG1S = VDS = 0)	I _{G2SS}	_	± 10	nA
Gate 1 to Source Cutoff Voltage (V _{DS} = 15 V, V _{G2S} = 4.0 V, I _D = 20 μ A)	VG1S(off)	-0.5	-4.0	Vdc
Gate 2 to Source Cutoff Voltage (Vps = 15 V, Vg1s = 0 V, Ip = 20 μ A)	VG2S(off)	-0.2	-4.0	Vdc
ON CHARACTERISTICS				
			T	

Zero-Gate-Voltage Drain Current* (VDS = 15 V, VG2S = 4.0 V, VG1S = 0 V)	IDSS*	6	30	mA
SMALL-SIGNAL CHARACTERISTICS				

Forward Transfer Admittance $(V_{DS} = 15 \text{ V}, V_{G2S} = 4.0 \text{ V}, V_{G1S} = 0 \text{ V}, f = 1.0 \text{ kHz}) \text{ Note 2}$	Y _{fs}	10	22	mmhos
Input Capacitance $(V_{DS} = 15 \text{ V}, V_{G2S} = 4.0 \text{ V}, I_{D} = I_{DSS}, f = 1.0 \text{ Mhz})$	C _{iss}	Typ. 3.0		pF
Reverse Transfer Capacitance ($V_{DS} = 15 \text{ V}$, $V_{G2S} = 4.0 \text{ V}$, $I_{D} = 10 \text{ mA}$, $f = 1.0 \text{ MHz}$)	C _{rss}	0.005	0.03	pF
Output Capacitance (V _{DS} = 15 V, V _{G2S} = 4.0 V, I _D = I _{DSS} , f = 1.0 MHz)	Coss	Typ. 1.4		pF

Noise Figure		NF			dB
$(V_{DD} = 18 \text{ V}, V_{GG} = 7.0 \text{ V}, f = 200 \text{ MHz})$	3N204		_	3.5	
$(V_{DS} = 15 \text{ V}, V_{G2S} = 4.0 \text{ V}, I_{D} = 10 \text{ mA}, f = 450 \text{ MHz})$	3N204		_	5.0	
Common Source Power Gain		Gps			dB
$(V_{DD} = 18 \text{ V}, V_{GG} = 7.0 \text{ V}, f = 200 \text{ MHz})$	3N204	P	20	28	
$(V_{DS} = 15 \text{ V}, V_{G2S} = 4.0 \text{ V}, I_{D} = 10 \text{ mA}, f = 450 \text{ MHz})$	3N204		14	_	

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic				Min	Max	Unit
Bandwidth $(V_{DD} = 18 \text{ V, } V_{GG} = 7.0 \text{ V, } f = 200 \text{ MHz})$ $(V_{DD} = 18 \text{ V, } f_{LO} = 245 \text{ MHz, } f_{RF} = 200 \text{ MHz})$ (No.	ote 4)	3N3204 3N205	BW	7.0 4.0	12 7.0	MHz
Gain Control Gate-Supply Voltage (Note 3) (V _{DD} = 18 V, ΔGPS = 300 dB, f = 200 MHz)	risti	3N204	VGG(GC)	0	-2.0	Vdc
Conversion Gain (Note 4) (V _{DD} = 18 V, f _{LO} = 245 MHz, f _{RF} = 200 MHz)	Vite	3N205	G(conv.)	17	28	dB

*PW = 30 μ s, Duty Cycle \leq 2.0%.

(2) This parameter must be measured with bias voltages applied for less than five (5) seconds to avoid overheating. (2) This parameter must be measured with bias voltages applied for less than live to, social to the

N-CHANNEL DEPLETION		

	Gos	

⁽¹⁾ All gate breakdown voltages are measured while the device is conducting rated gate current. This insures that the gate voltage limiting network is functioning propertly.

WAXIIVOW RATINGS	0.6	1	1949		
Rating			Symbol	Value	Unit
Drain-Source Voltage	rain-Source Voltage		VDS	25	Vdc
Drain-Gate Voltage		7.0	V _{DG1} V _{DG2}	30 30	Vdc
Drain Current			ID	30	mAdc
Gate Current			IG1R IG1F IG2R IG2F	-10 10 -10 10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C			эл Рртано	300 1.71	mW mW/°C
Lead Temperature, 1/16" From Seated Surface for 10 seconds			TLO .	260	°C
Storage Channel Temperature Range			T _{stg}	-65 to +175	°C
Operating Channel Temperature			T _{channel}	175	°C

3N209

CASE 20-03, STYLE 9 TO-72 (TO-206AF)



DUAL-GATE MOSFET UHF COMMUNICATIONS

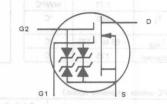
N-CHANNEL — DEPLETION

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

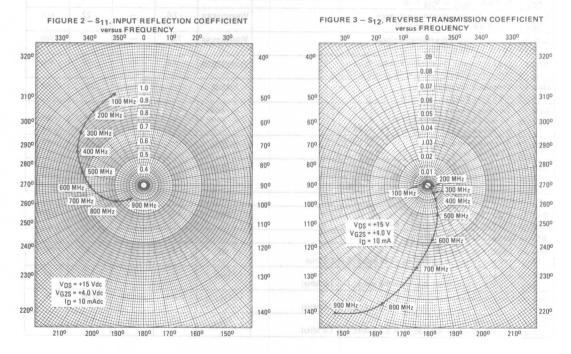
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (ID = 10 μ Adc, V _{G1S} = -4.0 Vdc, V _{G2S} = 4.0 Vdc)	V(BR)DS	χ 25	_	_	Vdc
Gate 1 — Source Forward Breakdown Voltage (IG1 = 10 mAdc, VG2S = VDS = 0)	V(BR)G1S	SF 7.0	_	22	Vdc
Gate 1 — Source Reverse Breakdown Voltage (IG1 = -10 mAdc, VG2S = VDS = 0)	V _(BR) G1S	SR -7.0	Man Tusio	-22	Vdc
Gate 2 — Source Forward Breakdown Voltage (IG2 = 10 mAdc, VG1S = VDS = 0)	V _(BR) G2S	SF 7.0	0 <u> </u>	22	Vdc
Gate 2 — Source Reverse Breakdown Voltage $(I_{G2} = -10 \text{ mAdc}, V_{G1S} = V_{DS} = 0)$	V(BR)G2S	SR -7.0		-22	Vdc
Gate 1 — Terminal Forward Current $(V_{G1S} = 6.0 \text{ Vdc}, V_{G2S} = V_{DS} = 0)$	IG1SSF	-		20	nAdc
Gate 1 — Terminal Reverse Current $(V_{G1S} = -6.0 \text{ Vdc}, V_{G2S} = V_{DS} = 0)$ $(V_{G1S} = -6.0 \text{ Vdc}, V_{G2S} = V_{DS} = 0, T_A = 150^{\circ}\text{C})$	IG1SSF	=	30 = 12 H	- 20 - 10	nAdc μAdc
Gate 2 — Terminal Forward Current ($V_{G2S} = 6.0 \text{ Vdc}$, $V_{G1S} = V_{DS} = 0$)	IG2SSF	-	3.0 -	20	nAdc
Gate 2 — Terminal Reverse Current $(V_{G2S} = -6.0 \text{ Vdc}, V_{G1S} = V_{DS} = 0)$ $(V_{G2S} = -6.0 \text{ Vdc}, V_{G1S} = V_{DS} = 0, T_A = 150^{\circ}\text{C})$	IG2SSF	_		-20 -10	nAdc μAdc
ON CHARACTERISTICS					
Gate 1 — Zero Voltage Drain Current (V _{DS} = 15 Vdc, V _{G1S} = 0, V _{G2S} = 4.0 Vdc)	IDSS	5.0		30	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance ($V_{DS}=15~V_{dc},V_{G2S}=4.0~V_{dc},I_{D}=10~mAdc,f=1.0~kHz$)	Yfs	10	13	20	mmhos
Input Capacitance (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID \geq 5.0 mAdc, f = 1.0 MHz)	C _{iss}		3.3	7.0	pF
Reverse Transfer Capacitance $(V_{DS}=15~Vdc, V_{G2S}=4.0~Vdc, I_{D} \ge 5.0~mAdc, f=1.0~MHz)$	C _{rss}	0.005	0.023	0.03	pF
Output Capacitance (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID \geqslant 5.0 mAdc, f = 1.0 MHz)	Coss	0.5	2.0	4.0	pF

Characteristic	Symbol	Min	Тур	Max	Unit	
FUNCTIONAL CHARACTERISTICS						
Noise Figure $(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_{D} = 10 \text{ mAdc}, f = 500 \text{ MHz})$	vaiso	NF lodmy?	_	4.0	6.0	dB
Common Source Power Gain (Figure 12) (V _{DS} = 15 Vdc, V _{G2S} = 4.0 Vdc, I _D = 10 mAdc, f = 500 MHz)	25 30	Gps	10	13	20	dB
*Bandwidth (Vps = 15 Vdc, V _{G2S} = 4.0 Vdc, Ip = 10 mAdc, f = 500 MHz)	30	BW 9	7.0	-	17	MHz

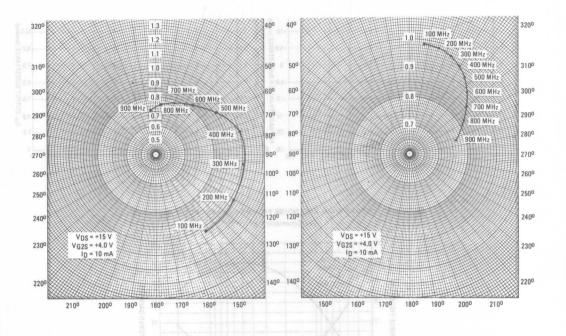
FIGURE 1 - MOSFET CIRCUIT SCHEMATIC



TYPICAL SCATTERING PARAMETERS







TYPICAL COMMON-SOURCE ADMITTANCE PARAMETERS

(VDS = 15 Vdc, VGS2 = 4.0 Vdc, ID = 10 mAdc)

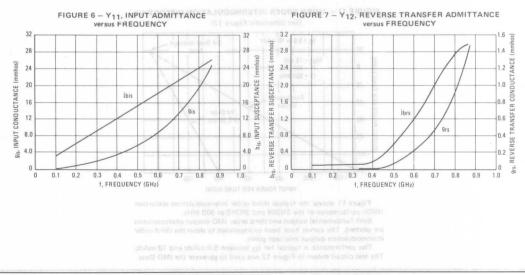


FIGURE 8 — Y₂₁, FORWARD TRANSFER ADMITTANCE versus FREQUENCY

FIGURE 9 – Y₂₂, OUTPUT ADMITTANCE versus FREQUENCY

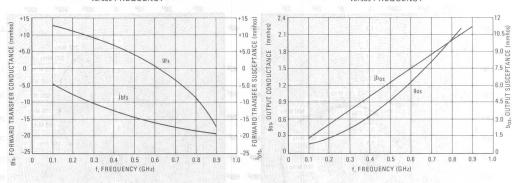
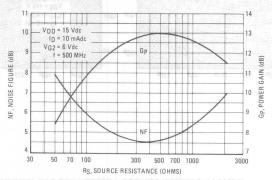


FIGURE 10 – POWER GAIN AND NOISE FIGURE versus SOURCE RESISTANCE (See Schematic Figure 12)



The Test Circuit shown in Figure 12 was used to generate Power Gain and Noise Figure as a function of Source Resistance curves.

AATHMOA SARAMARY SEE FIGURE 11 - THIRD ORDER INTERMODULATION DISTORTION

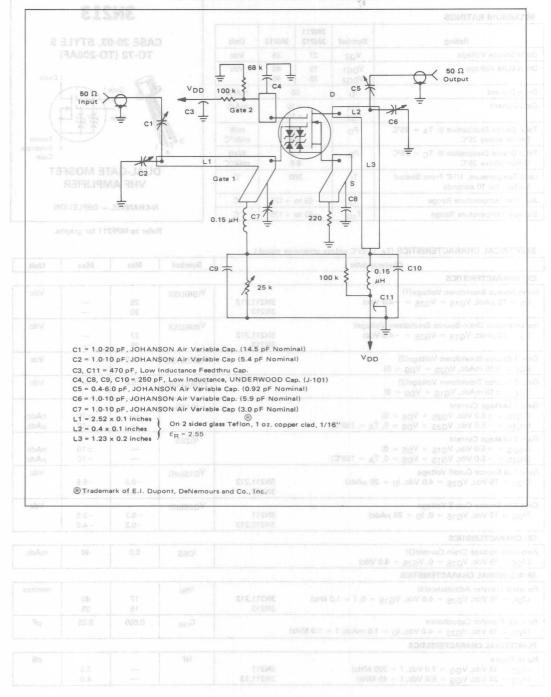
(See Schematic Figure 12) Ip = 5.0 to 10 mAdc 3rd Order Intercept 20 Point dBM) V_{DS} = 15 Vdc f1 = 499 MHz f2 = 500 MHzTONE -20 PER Fundamental -40 Output 3rd Order IMD Output DUTPUT -80 -100 -120 -100 O TANKS YOUR -80 -60 -40 -20 INPUT POWER PER TONE (dBM)

Figure 11 shows the typical third order intermodulation distortion (IMD) performance of the 3N209 and 3N210 at 500 MHz.

Both fundamental output and third order IMD output characteristics are plotted. The curves have been extrapolated to show the third order intermodulation output intercept point.

The performance is typical for I_D between 5.0 mAdc and 10 mAdc. The test circuit shown in Figure 12 was used to generate the IMD Data.

FIGURE 12 - TEST CIRCUIT FOR POWER GAIN, NOISE FIGURE AND THIRD ORDER INTERMODULATION DISTORTION



ORDER INTERHODULATION DISTORTION

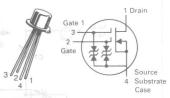
3N211 3N212 3N213

FIGURE 12 -AND THE

MAXIMUM RATINGS

Rating	Symbol	3N211 3N212	3N213	Unit
Drain-Source Voltage	V _{DS}	27	35	Vdc
Drain-Gate Voltage or pa	V _{DG1} V _{DG2}	35 35	40 40	Vdc
Drain Current	ID	Ę	50	mAdc
Gate Current	IG1 IG2	7	mAdc	
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	360 2.4		mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.2 8.0		Watt mW/°C
Lead Temperature, 1/16" From Seated Surface for 10 seconds	TL	300		°C are
Junction Temperature Range	TJ	-65 to +175		°C
Storage Temperature Range	T _{stg}	- 65 t	0 + 175	°C

CASE 20-03, STYLE 9 TO-72 (TO-206AF)



DUAL-GATE MOSFET VHF AMPLIFIER

N-CHANNEL — DEPLETION

Refer to MPF211 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	N. I				
Drain-Source Breakdown Voltage(1) (I _D = 10 μAdc, V _{G1S} = V _{G2S} = -4.0 Vdc)	3N211,212 3N213	V(BR)DSX	25 30	_	Vdc
Instantaneous Drain-Source Breakdown Voltage) (ID = 10 μ Adc, VG1S = VG2S = -4.0 Vdc)	3N211,212 3N213	V(BR)DSX	27 35	tar k n	Vdc
Gate 1-Source Breakdown Voltage(2) (IG1 = ±10 mAdc, VG2S = VDS = 0)	s Cap (5.4 pF Nominal) thru Cap.	V(BR)G1SO	woJ .4g 0\	(0) - (10) (1) - (1) (1) (1)	Vdc
	es, UNDERWOOD Cap a Ces. 10:32 pf Nomin	V(BR)G2SO	± 6.0	84.0 4 61	Vdc
Gate 1 Leakage Current (VG1S = \pm 5.0 Vdc, VG2S = VDS = 0) (VG1S = $-$ 5.0 Vdc, VG2S = VDS = 0, TA = 150° C) and balls	Cap (3.6 pF Nominal) (6) (7) (8) (9) (1) (1) (1) (2) (2) (3)		MAKOL Par 20 1 manual 20 1 manual	±10 -10	nAdc μAdc
Gate 2 Leakage Current $(V_{G2S} = \pm 5.0 \text{ Vdc}, V_{G1S} = V_{DS} = 0) $ $(V_{G2S} = -5.0 \text{ Vdc}, V_{G1S} = V_{DS} = 0, T_{A} = 150^{\circ}\text{C})$		G2SS	6.2 Inches	±10 -10	nAdc μAdc
Gate 1 to Source Cutoff Voltage ($V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_{D} = 20 \mu \text{Adc}$)	3N211,213 3N212 brief	VG1S(off)	-0.5 -0.5	- 5.5 - 4.0	Vdc
Gate 2 to Source Cutoff Voltage ($V_{DS} = 15 \text{ Vdc}, V_{G1S} = 0, I_D = 20 \mu \text{Adc}$)	3N211 3N212,213	VG2S(off)	- 0.2 - 0.2	-2.5 -4.0	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(3) $(V_{DS} = 15 \text{ Vdc}, V_{G1S} = 0, V_{G2S} = 4.0 \text{ Vdc})$		IDSS	6.0	40	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance(4) ($V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, V_{G1S} = 0, f = 1.0 \text{ kHz}$)	3N211,212 3N213	Yfs	17 15	40 35	mmhos
Reverse Transfer Capacitance (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = 1.0 mAdc, f = 1.0 MHz	Hz)	C _{rss}	0.005	0.05	pF
FUNCTIONAL CHARACTERISTICS					-
Noise Figure $(V_{DD} = 18 \text{ Vdc}, V_{GG} = 7.0 \text{ Vdc}, f = 200 \text{ MHz})$ $(V_{DD} = 24 \text{ Vdc}, V_{GG} = 6.0 \text{ Vdc}, f = 45 \text{ MHz})$	3N211 3N211,13	NF	_	3.5 4.0	dB

Common Source Fower Gain		Gps		1	dB
$(V_{DD} = 18 \text{ Vdc}, V_{GG} = 7.0 \text{ Vdc}, f = 200 \text{ MHz})$	3N211		24	35	
$(V_{DD} = 24 \text{ Vdc}, V_{GG} = 6.0 \text{ Vdc}, f = 45 \text{ MHz})$	3N211		29	37	
$(V_{DD} = 24 \text{ Vdc}, V_{GG} = 6.0 \text{ Vdc}, f = 45 \text{ MHz})$	3N213		27	35	
$(V_{DD} = 18 \text{ Vdc}, f_{LO} = 245 \text{ MHz}, f_{RF} = 200 \text{ MHz})$	3N212	G _C (6)	21	28	
Bandwidth and STYLE 23 and Albindon		BW			MHz
$(V_{DD} = 18 \text{ Vdc}, V_{GG} = 7.0 \text{ Vdc}, f = 200 \text{ MHz})$	3N211		5.0	12	
$(V_{DD} = 18 \text{ Vdc}, f_{LO} = 245 \text{ MHz}, f_{RF} = 200 \text{ MHz})$	3N212		4.0	7.0	
$(V_{DD} = 24 \text{ Vdc}, V_{GG} = 6.0 \text{ Vdc}, f = 45 \text{ MHz})$	3N211,213		3.5	6.0	MAY XIM
Gain Control Gate-Supply Voltage(5)	- Value	VGG(GC)		Rating	Vdc
$(V_{DD} = 18 \text{ Vdc}, \Delta G_{ps} = -30 \text{ dB}, f = 200 \text{ MHz})$ $(V_{DD} = 24 \text{ Vdc}, \Delta G_{ps} = -30 \text{ dB}, f = 45 \text{ MHz})$	3N211 2N211,213	egV- I	_	-2.0 ±1.0	MARIE MAR

(1) Measured after five seconds of applied voltage.

(2) All gate breakdown voltages are measured while the device is conducting rated gate current. This ensures that the gate-voltage limiting network is functioning properly.

(3) Pulse Test: Pulse Width = 300 μ s, Duty Cycle \leq 2.0%.

(4) This parameter must be measured with bias voltages applied for less than 5 seconds to avoid overheating. The signal is applied to gate 1 with gate 2 at ac ground.

(5) ΔG_{pg} is defined as the change in G_{ps} from the value at $V_{GG}=7.0$ Volts (3N211) and $V_{GG}=6.0$ Volts (3N213). (6) Power Gain Conversion. Amplitude at input from local oscillator is adjusted for maximum G_{c} .

	8F245(1), 8F244[2) 8F245A, 8F244A 8F245B, 8F24AB 8F245C, BF24AC			
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BF244,A,B,C

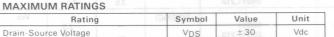
CASE 29-04, STYLE 22 TO-92 (TO-226AA)



BF245,A,B,C

CASE 29-04, STYLE 23 TO-92 (TO-226AA)





Drain-Source Voltage	VDS	±30	Vdc
Drain-Gate Voltage	VDG	30	Vdc
Gate-Source Voltage	VGS	30	Vdc
Drain Current	ID	100	mAdc
Forward Gate Current	IG(f)	1.0	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD pasy brie	360	mW mW/°C
Storage Channel Temperature Range	Tstg	-65 to +150	CIELIOC ISC

JFET VHF/UHF AMPLIFIER

N-CHANNEL - DEPLETION

Refer to 2N4416 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characte	Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS						
Gate-Source Breakdown Voltage (IG = 1.0 µAdc, VDS = 0)		V(BR)GSS	30	_	_	V
Gate-Source (VDS = 15 Vdc, I_D = 200 μ A)	BF245(1), BF244(2) BF245A, BF244A BF245B, BF244B BF245C, BF244C	VGS	0.4 0.4 1.6 3.2		7.5 2.2 3.8 7.5	V
Gate-Source Cutoff Voltage (VDS = 15 Vdc, ID = 10 nA)		VGS(off)	0.5	_	8	V
Gate Reverse Current (VGS = 20 Vdc, VDS = 0)		IGSS	_	_	5	nA
ON CHARACTERISTICS						
Zero-Gate Voltage Drain Current (VDS = 15 Vdc, VGS = 0)	BF245(1), BF244(2) BF245A, BF244A BF245B, BF244B BF245C, BF244C	DSS	2 2 6 12		25 6.5 15 25	mA
SMALL-SIGNAL CHARACTERISTICS						
Forward Transfer Admittance (VDS = 15 Vdc, VGS = 0, f = 1 KHz)		Yfs	3.0		6.5	mmhos
Output Admittance (VDS = 15 Vdc, VGS = 0, f = 1 KHz)		[Yos]		40		μmhos
Forward Transfer Admittance (VDS = 15 Vdc, VGS = 0, f = 200 MH	Hz)	Yfs		5.6		mmhos
Reverse Transfer Admittance $(VDS = 15 Vdc, VGS = 0, f = 200 MH)$	Hz)	Y _{rs}		1.0		mmhos
Input Capacitance (VDS = 20 Vdc, -VGS = 1 Vdc)		Ciss		3		pF
Reverse Transfer Capacitance (VDS = 20 Vdc, -VGS = 1 Vdc, f = 1	MHz)	C _{rss}		0.7		pF
Output Capacitance (VDS = 20 Vdc, -VGS = 1 Vdc, f = 1	MHz)	Coss		0.9		pF
Noise Figure (VDS = 15 Vdc, VGS = 0, RG = 1 K Ω ,	f = 100 MHz)	NF		1.5		db
Cut-off Frequency(3) (VDS = 15 Vdc, VGS = 0)		F(Yfs)		700		MHz

- (1) On orders against the BF245, any or all subgroups might be shipped. (2) On orders against the BF244, any or all subgroups might be shipped. (3) The frequency at which gfs is 0.7 of its value at 1 KHz.

BF256,A,B,C

CASE 29-04, STYLE 23 TO-92 (TO-2264A)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	55V ±25	Vdc
Drain-Gate Voltage	VDG	25	Vdc
Gate-Source Voltage	VGS	15V 25	Vdc
Drain Current	ID	100	mAdc
Forward Gate Current	IG(f)	BAm 10	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	360 2.88	mW/°C
Storage Channel Temperature Range	Tstg	-65 to +150	or a °C

BF246,A,B,C

CASE 29-04, STYLE 22 Gi TO-92 (TO-226AA)



BF247,A,B,C

CASE 29-04, STYLE 5 TO-92 (TO-226AA)





SWITCHING

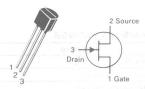
N-CHANNEL - DEPLETION

Refer to MPF4391 for graphs.

Character	istic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			apite	RARTER			
Gate-Source Breakdown Voltage (IG = 1 μA, VDS = 0)	V(8F))GSS		V(BR)GSS	25	down Volty	Japane Broad V Ja lob u C	V
Gate-Source (VDS = 15 V, ID = 200 μ A)	BF246, BF246A.	BF247 BF247A	VGS	0.5	ej 0 01 - g	14 et	V
	BF246B, BF246C,	BF247B BF247C		3 5.5	(0 <u>=</u> 20)	7 12	an dili
Gate-Source Cutoff Voltage (VDS = 15 V, ID = 10 nA)	ead		VGS(off)	0.6	ings Drei s S um	14.5	V
Gate Cutoff Current (VGS = 15 V, VDS = 0)			IGSS	_	- (A = SS)	5	nA
ON CHARACTERISTICS			BEZEBC				
Zero-Gate Voltage Drain Current (VDS = 15 V, VGS = 0)	BF246A, BF246A, BF246B, BF246C,	BF247 BF247A BF247B BF247C	IDSS	30 30 60 110	ARACTE Imitrance GS = 0.1 Ipacilance	250 80 140 250	- L mA
SMALL-SIGNAL CHARACTERISTICS			[3]	TWEET F (a)	ACE	apy us	
Forward Transfer Admittance (VDS = 15 V, ID = 10 mA, f = 1 kHz)	8309		Yfs	8	23	20 Vele, V	mmhos
Reverse Transfer Capacitance (VDS = 15 V, ID = 10 mA, f = 1 kHz)	SM		Crss	FIM 008 -	3.3	10 Vdq. R	pF
Input Capacitance (VDS = 15 V, ID = 10 mA, f = 1 MHz)	atgi		Cin		6	is Vds, V	pF
Output Capacitance (VDS = 15 V, ID = 10 mA, f = 1 MHz)	d _B		Cout	HM 008 -	5	15 Vds, f	pF
Cutoff Frequency (VDS = 15 V, VGS = 0)			F(Yfs)	in to the a	450	ite vaneur iteney vit	MHz

Rating	Symbol	Value	Unit	
Drain-Source Voltage	VDS	abV ±30 8	Vdc	
Drain-Gate Voltage	VDG	30	Vdc	
Gate-Source Voltage	VGS	30 Velo	Vdc	
Drain Current	ID	DAm 100	mAdc	
Forward Gate Current	IG(f)	bAm 10	mAdc	
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD	7/m 360 7/4/2.88	mW mW/°C	
Storage Channel Temperature Range	T _{stg}	= 65 to +150	of dec	

CASE 29-04, STYLE 23 TO-92 (TO-226AA)



JFET VHF/UHF AMPLIFIER N-CHANNEL - DEPLETION

Refer to 2N4416 for graphs.

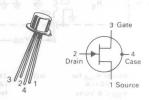
ELECTRICAL CHARACTERISTICS

TinU XEM GWT Characteris	stic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		Harriston or have			50136	The second	7 Tag
Gate-Source Breakdown Voltage (IG = 1.0 µAdc, VDS = 0)	V(BR)OSS		V _(BR) GSS	30 90	STICK_DATE		Vdc
Gate-Source Voltage (VDS = 15 Vdc, ID = 200 μ A)	sov	Bezaz	VGS(off)	0.5	200 pA)	7.5	Vdc
Gate Reverse Current (VGS = 20 Vdc, VDS = 0)		BF2A7B BF2A7B	IGSS		_	5	nAdc
ON CHARACTERISTICS	www.poW				SHERON	in c	02 (tax)
Zero-Gate Voltage Drain Current) 8.0 (VDS = 15 Vdc, VGS = 0)	BF256(1) BF256A BF256B BF256C		IDSS	3 3 6 11	- A O	18 7 13 18	mAdc
SMALL-SIGNAL CHARACTERISTICS	ead!			İfe	ettuð ma	THE T	1681 45
Forward Transfer Admittance (VDS = 15 Vdc, VGS = 0, f = 1 kHz)		BF2A7A	ABAYfs	4.5	5	_	mmhos
Reverse Transfer Capacitance $(V_{DS} = 20 \text{ Vdc}, -V_{GS} = 1 \text{Vdc}, f = 1 \text{ M})$	Hz)	BF247C	O Crss	EDITE	0.7	 D.18500	pF
Output Capacitance (VDS = 20 Vdc, VGS = 0, f = 1 MHz)	2)Y		Coss	1.68.1	1.0		pF
Noise Figure (VDS = 10 Vdc, $R_S = 47\Omega$, $f = 800$ MH	z) serJ		NF	INHAI I	7.5	o u st s ue	db
Cut-off Frequency(2) (VDS = 15 Vdc, VGS = 0)	Cin		fgfs	111101	1000		MHz
Power Gain (VDS = 15 Vdc, $R_S = 47 \Omega$, $f = 800 MH$	z) tuoD	01-1-10-11	Gp	YCHMT I	11 L Accord		dB

(1) On orders against the BF256, any or all subgroups might be shipped. (2) The frequency at which gfs is 0.7 of its value at 1 kHz.

BFW10 BFW11

CASE 20-03, STYLE 1 TO-72 (TO-206A)



JFET VHF/UHF AMPLIFIER

N-CHANNEL - DEPLETION

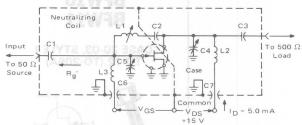
Refer to 2N4416 for graphs.

MAXIMUM RATINGS

**Hat Rating Hater 0	Symbol	Value	Unit
Drain-Source Voltage	VDS	30	Vdc
Drain-Gate Voltage	VDG	30 0 31	Vdc
Reverse Gate-Source Voltage	VGSR	-30	Vdc
Forward Gate Current	IGF	10	mAdc
Total Device Dissipation @ TA = 25°C Derate above 25°C	PD and	300 1.71	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, Tstg	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteris	tic	Tohannel = 25°C)	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	FIGURE		CE VOLTAGE	RUOE MA	RO 30 873	2 - 6576	FIGURE
Gate-Source Breakdown Voltage (IG = 10 μAdc, VDS = 0)		723	V(BR)GSS	30			Vdc
Gate-Source Cutoff Voltage (VDS = 15 Vdc, ID = 0.5 nAdc)	BFW10 BFW11	- E-E	VGS(off)			8 6	Vdc
Gate Reverse Current (VGS = 20 Vdc, VDS = 0)	XII		IGSS		21/30 00	0.1	nAdc
Gate-Source Voltage (VDS = 15 Vdc, ID = 400 μAdc)	BFW10	- 53	VGS	2		7.5	Vdc
Gate-Source Voltage (VDS = 15 Vdc, ID = 50 μAdc)	BFW11	9 9	VGS	1.25		4	Vdc
ON CHARACTERISTICS	0.001						
Zero-Gate Voltage Drain Current (VDS = 15 Vdc, VGS = 0)	BFW10 BFW11		IDSS	8 4		20	mAdc
SMALL-SIGNAL CHARACTERISTICS		121					
Forward Transadmittance (VDS = 15 Vdc, VGS = 0, f = 1 kHz)	BFW10 BFW11		Yfs (27)	3.5 3.0	AIN SOURCE	6.5 6.5	mmhos
Output Admittance (VDS = 15 Vdc, VGS = 0, f = 1.0 kHz)	BFW10 BFW11		Yos		=	85 50	μmhos
Input Capacitance (VDS = 15 Vdc, VGS = 0 Vdc, f = 1.0 MI	Hz)		C _{iss}	_	_	5.0	pF
Reverse Transfer Capacitance (VDS = 15 Vdc, VGS = 0 Vdc, f = 1.0 MI	Hz)		C _{rss}		_	0.8	pF
Forward Transadmittance (VDS = 15 Vdc, VGS = 0, f = 200 MHz)			Yfs	3.2	_	_	mmhos
Equivalent Noise Voltage (VDS = 15 Vdc, VGS = 0, f = 25 Hz)	·		en	_		75	nV/VHz
Noise Figure (VDS = 15 Vdc, VGS = 0 V, see Figures	1, 2, 3)		NF	_	_	2.5	dB



į	Coil	- 40 01		2	 C3 1	←
o 50 Ω Source	C1 	L3 {	C5	Con	D = 5.0	To 500 Ω Load

Reference	VA	LUE
Designation	100 MHz	400 MHz
C1	7.0 pF	1.8 pF
C2	1000 pF	17 pF
С3	3.0 pF	1.0 pF
C4	1-12 pF	0.8-8.0 pF
C5	1-12 pF	0.8-8.0 pF
C6	C.0015 μF	0.001 μF
C7	0.0015 μF	0.001 μF
L1	3.0 µH*	0.2 μΗ**
Y8 L2	0.15 μΗ*	0.03 μΗ**
/ L3	0.14 μΗ*	0.022 µH * *

Adjust V_{GS} for I_D = 50 mA V_{GS}< 0 Volts

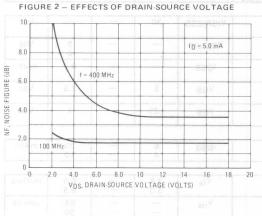
NOTE: The noise source is a hot-cold body (AIL type 70 or equivalent) with a test receiver (AIL type 136 or equivalent).

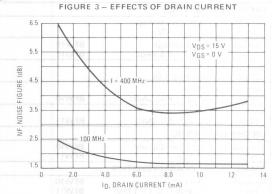
- *L1 17 turns, (approx. depends upon circuit layout) AWG #28 enameled copper wire, close wound on 9/32" ceramic coil form. Tuning provided by a powdered iron slug.
- L2 4-1/2 turns, AWG #18 enameled copper wire, 5/16" long, 3/8" I.D. (AIR CORE).
- L3 3-1/2 turns, AWG #18 enameled copper wire, 1/4" long,
- **L1 6 turns, (approx. depends upon circuit layout) AWG #24 enameled copper wire, close wound on 7/32" ceramic coil form. Tuning provided by an aluminum slug.
 - 1 turn, AWG #16 enameled copper wire, 3/8" I.D. (AIR CORE).
 - 1/2 turn, AWG #16 enameled copper wire, 1/4" I.D. (AIR CORE).

NOISE FIGURE

L3

rintl kaM gyf piM lodmy@ (T_{channel} = 25°C)





85170

CASE 29-04, STYLE 30

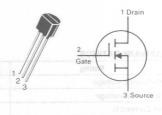
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	200	Vdc
Gate-Source Voltage	VGS	±20	Vdc
Drain Current Continuous(1) Pulsed(2)	I _D	250 500	mAdc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	20 8.0 Vd	Watts
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to 150	o °C

⁽¹⁾ The Power Dissipation of the package may result in a lower continuous drain current.

BS107,A

CASE 29-04, STYLE 30 TO-92 (TO-226AA)



TMOS SWITCHING

N-CHANNEL — ENHANCEMENT

Refer to MFE9200 for graphs.

200

9fs

ton

toff

400

6.0

15

15

mmhos

ns

Characteris	stic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	99%				nerson Curren	or Figure 17 av
Zero-Gate-Voltage Drain Current (VDS = 130 V, VGS = 0)	Viganoce	IDSS		40 = ,	gV 30 81	nAdc
Drain-Source Breakdown Voltage (V _{GS} = 0, I _D = 100 μA)		V(BR)DSX	200	35 µA+	C. I . a. 1 RACTERIS	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0)	Vesimo	IGSS	_	0.01	10 10	nAdc
ON CHARACTERISTICS*					i menso2-i-la	statue Dr
Gate Threshold Voltage (I _D = 1.0 mA, V _{DS} = V _{GS})	(Market)	VGS(Th)	1.0	(Air-005	0 3.0 l	Vdc
Static Drain-Source On Resistance BS107 (V _{GS} = 2.6 V, I _D = 20 mA) (V _{GS} = 10 V, I _D = 200 mA)	210	rDS(on)		clance 250 mA)	28	Ohms
BS107A (VGS = 10 Vdc) (ID = 100 mA) (ID = 250 mA)			.0 MHz)		6.0 6.4	SUSTAINS
SMALL-SIGNAL CHARACTERISTICS						
Input Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MHz)	110	C _{iss}	-	60	9.2 A) See	pF
Reverse Transfer Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	1107	C _{rss}	_	6.0	0.2 AT Sea	pF
Output Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)		C _{oss}	_	30	_	pF

Forward Transconductance

Turn-On Time

Turn-Off Time

 $(V_{DS} = 25 \text{ V}, I_D = 250 \text{ mA})$ SWITCHING CHARACTERISTICS

⁽²⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

BS107,A

CASE 29-04, STYLE 30 TO-92 (TO-228AA)

MAXIMUM BATINGS

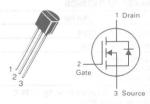
6

Symbol	Value	Unit
V _{DS}	60	e Vdc
VGS	± 20 a	Vdc
ID	0.5	Adc
PD	0.83	Watt
TJ, T _{stg}	-55 to +150	°C 3 lower co
	V _{DS} V _{GS} I _D P _D	VDS 60 VGS ±20 ID 0.5 PD 0.83 TJ, Tsta -55 to +150

(1) The Power Dissipation of the package may result in a lower continuous drain

BS170

CASE 29-04, STYLE 30 TO-92 (TO-226AA)



TMOS FET SWITCHING

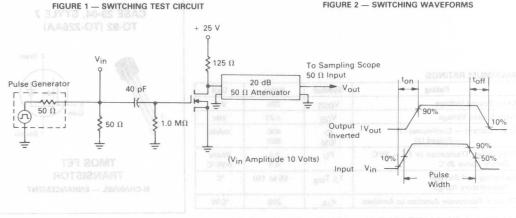
N-CHANNEL — ENHANCEMENT

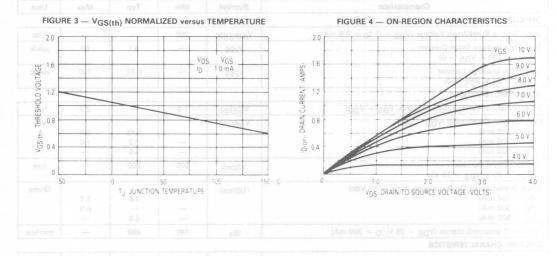
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

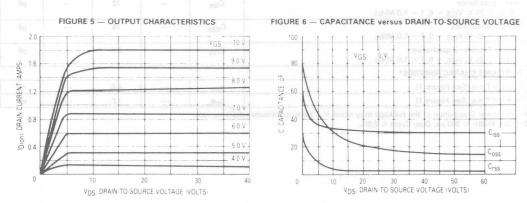
Ch	aracteri	stic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	niNi	Symbol		pite	Character			-
Gate Reverse Current (VGS = 15 V, VDS = 0)		eag!	1	IGSS		0.01	10	nAdc
Drain-Source Breakdown Voltage (VGS = 0, ID = 100 μA)	200	V(BR)DSX		V _{(BR)DSS}	.60	90		Vdc
ON CHARACTERISTICS(2)			1117 - A 1721 - 114			(6.0)	hi	C314
Gate Threshold Voltage (VDS = VGS, ID = 1.0 mA)		ssal		V _{GS} (Th)	0.8	2.0	3.0	Vdc
Static Drain-Source On Resistance (VGS = 10 V, ID = 200 mA)	0.1	Vesithi		rDS(on)	_	1.8	5.0	Ohms
Drain Cutoff Current (VDS = 25 V, VGS = 0 V)		Inclied ¹		ID(off)		165 <u>14</u> s	0.5	μА
Forward Transconductance (V _{DS} = 10 V, I _D = 250 mA)				9fs	_	200	J -	mmhos
SMALL-SIGNAL CHARACTERISTIC	S					West Cove		
Input Capacitance (VDS = 10 V, VGS = 0, f = 1.0 I	MHz)			C _{iss}	_	60		pF
SWITCHING CHARACTERISTICS	-		de la la la la la la la la la la la la la					- 0.
Turn-On Time (I _D = 0.2 A) See Figure 1		agi-P		ton	83/1	4.0	10	ns
Turn-Off Time (ID = 0.2 A) See Figure 1		Cres		toff	ISHIVE O.	4.0	10	ns

(2) Pulse Test: Pulse Width \leq 300 $\mu s,$ Duty Cycle \leq 2.0%.

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





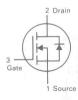


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

BSS89

CASE 29-04, STYLE 7 TO-92 (TO-226AA)





TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	200	Vdc
Gate-Source Voltage	VGS	± 20	Vdc
Drain Current — Continuous (1) — Pulsed (2)	I _D	400 800	mAdc
Total Power Dissipation @ T _A = 25°C Derate above 25°C	P _D (and	0.6 4.8	Watts mW/°C
Operating and Storage Temperature Range	TJ, T _{stg}	- 55 to 150	°C
Thermal Resistance Junction to Ambient	θ JA	208	°C/W

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

nbol	Min	Тур	Max	Unit
R)DSS	200			Vdc
SS	. 	0.1	60	μAdc
SS	g ¹	0.01	100	nAdd
S(th)	1.0		2.7	Vdc
S(on)	_	0.45 1.2	0.6	Vdc
			- 0.45	- 0.45 0.6 - 1.2 1.8

(ID = 300 IIIA)			0.0		
On-State Drain Current (VDS = 25 V, VGS = 10 V)	I _D (on)	500	700	_	mA
Static Drain-Source On-Resistance ($V_{GS}=10~Vdc$) ($I_{D}=150~mA$) ($I_{D}=300~mA$) ($I_{D}=500~mA$)	rDS(on)	TO TRANSPORT	4.5 — 6.0	6.0 6.0	Ohms
Forward Transconductance (V _{DS} = 25 V, I _D = 300 mA)	9fs	140	400		mmhos

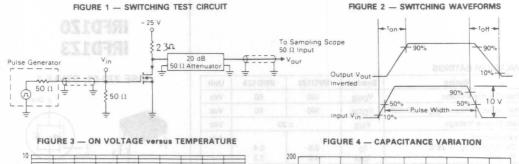
DYNAMIC CHARACTERISTICS

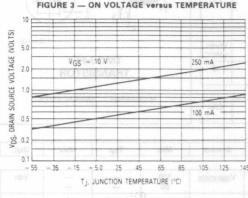
Input Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{iss}	_	72	_	pF
Output Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{oss}	IEEE JARAHU	15	3800-0	pF
Reverse Transfer Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MHz)	C _{rss}		2.8		pF

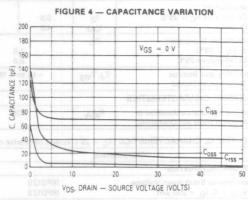
SWITCHING CHARACTERISTICS*

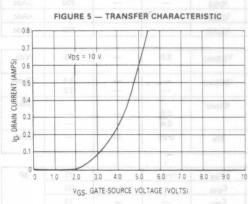
Turn-On Time (See Figure 1)	ton		6.0	e englisher	ns
Turn-Off Time (See Figure 1)	toff	-	12	-0	ns

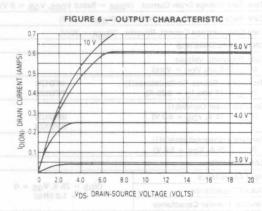
- (1) The Power Dissipation of the package may result in a lower continuous drain current.
- (2) Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

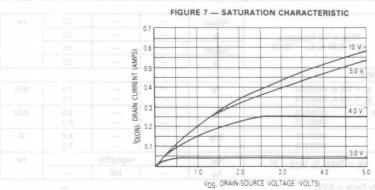












Total Power Dissipation
@ T_C = 25°C
Derate above 25°C
Operating and Storage

MAXIMUM RATINGS

Drain-Source Voltage

Gate-Source Voltage

Rating

Drain-Gate Voltage (RGS = $20 \text{ k}\Omega$)

Temperature Range
THERMAL CHARACTERISTICS
Thermal Resistance Junction to

hermal Resistance Junction to Ambient (Free Air Operation) R_{θ} JA

IRFD1Z0

100

0.5

4.0

Symbol

VDSS

VDGR

VGS

ID

IDM

PD

TJ, Tstg

IRFD1Z3

60

60

0.4

3.2

+ 20

1.0

8.0

-55 to +150

120

Unit

Vdc

Vdc

Vdc

Adc

Watts

mW/°C

°C

°C/W

9fs

0.25

IRFD1Z0 IRFD1Z3

CASE 370-01, STYLE 1





mhos

TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25 °C unless otherwise noted.)

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	PM - RC1 - RC1		35 35 53		- of iv
Drain-Source Breakdown Voltage IRFD1Z0 (VGS = 0, ID = 250 µA) IRFD1Z3	V _{(BR)DSS}	100 60	RMST <u>RO</u> CIONU.		Vdc
Zero Gate Voltage Drain Current (VDSS = Rated VDSS, VGS = 0 V)	IDSS	_	_	250	μAdc
Gate-Body Leakage Current, Forward (VGSF = 20 V)	IGSSF	R CH A RACTI	Basil an t —	3 500	nAdc
Gate-Body Leakage Current, Reverse (VGSR = 20 V)	IGSSR			500	nAdc
ON CHARACTERISTICS					
Gate Threshold Voltage (I _D = 250 μ A, V _{DS} = V _{GS})	VGS(th)	2.0		4.0	Vdc
Static Drain-Source On-Resistance(1) IRFD1Z0 (VGS = 10 Vdc, ID = 0.25 A) IRFD1Z3	rDS(on)	=	\ -	3.4 3.2	Ohms
On-State Drain Current(1) (VGS = 10 V, VDS = 5.0 V) IRFD1Z0	I _{D(on)}	0.5	1		Adc

CA	DA	CIT	FA	D. I	OF
CA	PA		IA	יציו	CE

Input Capacitance	08 08 04 05 0	Ciss	61 -68	je ∪. 11	70	pF
Output Capacitance	$(V_{DS} = 25 \text{ V}, V_{GS} = 0)$ f = 1.0 MHz	Coss	(81JO V 3 8A1	ATE SU W 806 VOL	30	
Reverse Transfer Capacitance	1.0 11112/	C _{rss}	_	_	10	

SWITCHING CHARACTERISTICS

Forward Transconductance(1)

 $(I_D = 0.25 \text{ A}, V_{DS} = 5.0 \text{ V})$

Turn-On Delay Time		td(on)	·	_	20	ns
Rise Time	(V _{DS} ≈ 0.5 V _{(BR)DSS} ,	t _r		_	25	
Turn-Off Delay Time	$I_D = 0.25 \text{ A}, Z_O = 50 \Omega)$	t _d (off)			25	
Fall Time		tf		Ē. —	20	

SOURCE-DRAIN DIODE CHARACTERISTICS

COUNTED DISTRICT DIODE ON THE TOTAL DISTRICT	00			25		
Diode Forward Voltage $(V_{GS} = 0)(1)$	I _S = 0.5 A, IRFD1Z0 I _S = 0.4 A, IRFD1Z3	VF	- 1		1.4 1.3	Vdc
Continuous Source Current, Body Diode		Is		# -	0.5	Adc
	IRFD1Z3			_	0.4	
Pulsed Source Current, Body Diode	IRFD1Z0	ISM	3/-	5 -	4.0	Α
	IRFD1Z3			_	3.2	
Forward Turn-On Time	(Is = Rated Is, VGS = 0)	ton		negligible		ns
Reverse Recovery Time	80 40 50	trr 0	_	100	_	

(1) Pulse Test: Pulse Width \leq 300 $\mu s,$ Duty Cycle \leq 2.0%.

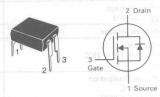
WAXIIIIOW NATINGS				
Rating	Symbol	IRFD110	IRFD113	Unit
Drain-Source Voltage	V _{DSS}	100	60	Vdc
Drain-Gate Voltage (RGS = 20 k Ω)	VDGR	100	60	Vdc
Gate-Source Voltage	VGS	550 ± 20		Vdc
Drain Current Continuous T _C = 25°C Pulsed	I _D	1.0 8.0	0.8 6.4	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0		Watts mW/°C
Operating and Storage Temperature Range	T _J , T _{stg}	-55 to +150		°C

THERMAL CHARACTERISTICS

Thermal Resistance	R ₀ JA	120	°C/W
Junction to Ambient			and saden a

IRFD113

CASE 370-01, STYLE 1



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

EL ECTRICAL	CHARACTERISTICS	/T -	2500	I alam			1
ELECTRICAL	CHARACTERISTICS	(10 =	25°C	unless	otherwise	noted)

Characte	eristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		SSGINBIV			spatioV r	o Breakdayır	eur2 n.g
Drain-Source Breakdown Voltage (VGS = 0, I _D = 250 μA)	001	IRFD110 IRFD113	V(BR)DSS	100 60		ri 002 — Gi ii	Vdc
Zero Gate Voltage Drain Current (VD	SS = Rate	ed V _{DSS} , V _{GS} = 0 V)	IDSS	SS - unite	NAME OF THE PARTY	250	μAdc
Gate-Body Leakage Current, Forward	(VGSF =	20 V)	IGSSF	- 4894)	DIDMING DITS	500	nAdc
Gate-Body Leakage Current, Reverse	(VGSR =	-20 V)	IGSSR	= 8550	Sent Australia	-500	nAdc
ON CHARACTERISTICS						DUST TERM LO YO	
Gate Threshold Voltage (I _D = 250 μA, V _{DS} = V _{GS})	0.8	(dpsav	V _{GS(th)}	2.0	-laaV	4.0	Vdc
Static Drain-Source On-Resistance(1) (VGS = 10 Vdc, I _D = 0.8 A)	-	IRFD110 IRFD113	rDS(on)	_	TA 8.0	0.6 0.8	Ohms
On-State Drain Current(1) (VGS = 10 V, V _{DS} = 5.0 V)	8.1	IRFD110	ID(on)	1.0 0.8	_(v-o.8	O V. Vos =	Adc
Forward Transconductance(1) (I _D = 0.8 A, V _{DS} = 5.0 V)	0.0	afe	9fs	0.8	(F)eo	risco nd ucțar A. Vine = 5.	mhos
CAPACITANCE						33	AAHDA'S
Input Capacitance		Ciss	_		200	pF	
Output Capacitance		= 25 V, V _{GS} = 0 = 1.0 MHz)	Coss	ac VI		100	
Reverse Transfer Capacitance		1.0 340/12/	C _{rss}	-	eone	25	
SWITCHING CHARACTERISTICS		26.1					
Turn-On Delay Time			td(on)	<u> </u>	-	20	ns
Rise Time	(V _{DS}	≈ 0.5 V(BR)DSS,	tr	mes 1/1		25	
Turn-Off Delay Time	ID = 1	$0.8 \text{ A}, Z_0 = 50 \Omega)$	td(off)	0 - 0	_	25	
Fall Time		33	tf	_	-	20	omil' I
SOURCE-DRAIN DIODE CHARACTERIS	STICS			2317	ARE TO ARAH	BOOK WIA	
Diode Forward Voltage (VGS = 0)	$I_S = 1.0 A$ $I_S = 0.8 A$		V _F , roan	A 8.T = 8	(A E S9A)	2.5	Vdc
Continuous Source Current, Body Dio	de	IRFD110 IRFD113	ISETORR PECORR	_ 9	nt, Body Diad	Soul 0,1 Curre 8.0	Adc
Pulsed Source Current, Body Diode		IRFD110 IRFD113	ISM CHAR	=	lody Drode	8.0 6.4	A
Forward Turn-On Time	(Is = F	Rated Is, VGS = 0)	ton	du la	negligible	amil no-m	ns
Reverse Recovery Time	,	3/18/03 -/	t _{rr}	ici - Sii	100	emiT vesvo	



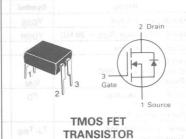
Rating	Symbol	IRFD120	IRFD123	Unit
Drain-Source Voltage	VDSS	100	60	Vdc
Drain-Gate Voltage $(R_{GS} = 20 \text{ k}\Omega)$	V _{DGR}	100	60	Vdc
Gate-Source Voltage	VGS	aby ±	20	Vdc
Drain Current Continuous T _C = 25°C Pulsed	I _D	1.3 5.2	1.1 4.4	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	and the second second	.0	Watts mW/°C
Operating and Storage Temperature Range	TJ, Tstg	- 55 to	+ 150	°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Ambient	$R_{\theta}JA$	120	°C/W
	385	2	22

IRFD120 IRFD123

CASE 370-01, STYLE 1



N-CHANNEL — ENHANCEMENT

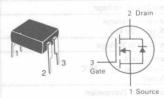
Charact	eristic		Lbaton e	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	niM	Symbol			righte	Characte		
Drain-Source Breakdown Voltage (VGS = 0, ID = 250 μ A)	100	IRFD120 IRFD123		V(BR)DSS	100 60	Voltage	Medical down	Vdc
Zero Gate Voltage Drain Current (V	OSS = Rate	ed V _{DSS} , V _{GS}	0 V)	IDSS	hote C	US General C	250	μAdo
Gate-Body Leakage Current, Forward				IGSSF		_	500	nAdo
Gate-Body Leakage Current, Reverse	(VGSR =	- 20 V)		IGSSR	300		-500	nAdd
ON CHARACTERISTICS		T. HERE'S			Hec		270 1 210 1	A
Gate Threshold Voltage (I _D = 250 μA, V _{DS} = V _{GS})	0.8	(m)sa/v		V _{GS(th)}	2.0	(20)	4.0	Vdc
Static Drain-Source On-Resistance(1) $(V_{GS} = 10 \text{ Vdc}, I_D = 0.6 \text{ A})$	-	IRFD120 IRFD123		rDS(on)	_	(1) au stance(1) 0.8-4)	0.3 0.4	Ohms
On-State Drain Current(1) (VGS = 10 V, V _{DS} = 5.0 V)	0.1	IRFD120 IRFD123		ID(on)	1.3 1.1	_{{{\{V,C,G,G,G,G,G,G,G,G,G,G,G,G,G,G,G,G,G,G,	8035, 11 I	Adc
Forward Transconductance(1) (I _D = 0.6 A, V _{DS} = 5.0 V)	8.0	919		9fs	0.9	_(Cap)	g = XI -	mhos
CAPACITANCE	,							324
Input Capacitance		sai?		Ciss	= 00V		600	pF
Output Capacitance		$= 25 \text{ V, V}_{GS} = 1.0 \text{ MHz}$	0	Coss	7 -		400	de de
Reverse Transfer Capacitance		1.0 ((11)2)		C _{rss}		3048	100	
SWITCHING CHARACTERISTICS						श्चाम दार	BIORRE	1 1 1 1 1
Turn-On Delay Time	-	Linelpi		t _{d(on)}	_		40	ns
Rise Time	(VDS	≈ 0.5 V(BR)DS	S,	0.5 V ₍₁ 38)DSS	- se <u>v</u>)		70	-fire
Turn-Off Delay Time		$0.6 \text{ A, } Z_0 = 50$		td(off)	01		100	the state
Fall Time				tf			70	1192
SOURCE-DRAIN DIODE CHARACTERI	STICS				800	SMITT DAMAM.	STOR WIN	7-3-3-071
Diode Forward Voltage (V _{GS} = 0)	I _S = 1.3 A I _S = 1.1 A			V _{SD}	A 0.1 = 3 A 8.0 = 3	1 (0 2g)V/I	2.5 2.3	Vdc
Continuous Source Current, Body Did	ode	IRFD120 IRFD123		Is	_ 9	int, Sody Dida	1.3 1.1	Adc
Pulsed Source Current, Body Diode		IRFD120 IRFD123		Ism	_	appid yao	5.2 4.4	А
Forward Turn-On Time	(c =	Rated Is, VGS =	= 0)	= ton2 os	(kg = Fig	negligible	emil itur	ns
Reverse Recovery Time	1.9	13, 103	,	t _{rr}	_	280	91111 V 150	D-17 - 1189

Rating	Symbol	IRFD210	IRFD213	Unit
Drain-Source Voltage	VDSS	200	150	Vdc
Drain-Gate Voltage $(R_{GS} = 20 \text{ k}\Omega)$	VDGR	200	150	Vdc
Gate-Source Voltage	VGS	t ±	20	Vdc
Drain Current Continuous T _C = 25°C Pulsed	I _D	0.6 2.5	0.45 1.8	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	1.0		Watts mW/°C
Operating and Storage Temperature Range	TJ, Tstg	- 55 to	°C	

 $R_{\theta JA}$

IRFD210 IRFD213

CASE 370-01, STYLE 1



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T _C = 25°C unless other	erwise noted.	1
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Thermal Resistance Junction to Ambient

Matt Seede Characte	eristic	Symbol S	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		THE RESERVE TO SERVE				ACTERISTICA	
Drain-Source Breakdown Voltage (VGS = 0, ID = 250 μ A)	200	IRFD210 IRFD213	V(BR)DSS	200 150	Vokage	0.10 = 250	Vdc
Zero Gate Voltage Drain Current (VD	SS = Rated	VDSS, VGS = 0 V)	IDSS	nsq = Rate	Current D	250	μAdc
Gate-Body Leakage Current, Forward	(VGSF = 2	(0 V)	IGSSF	= 95 51 (/) (rem. Forwar	500	nAdc
Gate-Body Leakage Current, Reverse	(VGSR =	- 20 V)	IGSSR	= aanV)	rent Havere	- 500	nAdc
ON CHARACTERISTICS						ACTERISTICS	ON CHAR
Gate Threshold Voltage (I _D = 250 μA, V _{DS} = V _{GS})	2.0	Vasanı	V _{GS(th)}	2.0	(anV	4.0	Vdc
Static Drain-Source On-Resistance(1) $(V_{GS} = 10 \text{ Vdc}, I_D = 0.3 \text{ A})$	_	IRFD210 IRFD213	rDS(on)	=	Resistance 1 0.4 AT	1,5	Ohms
On-State Drain Current(1) (VGS = 10 V, VDS = 5.0 V)	0.8	IRFD210, IRFD211 IRFD212, IRFD213	ID(on)	1.5 2.4		rain Currant 10 V, Vos =	Adc
Forward Transconductance(1) (I _D = 0.3 A, V _{DS} = 5.0 V)	0.5	e10	9fs	0.5	T/lebn (V 0.)	Houbitcokny	mhos
CAPACITANCE						3011	A COA TAD
Input Capacitance		Jan Charles	Ciss	_	_	150	pF
Output Capacitance	(V _{DS}	$= 25 \text{ V, V}_{GS} = 0$ = 1.0 MHz)	Coss	_Ed\/T	_	80	
Reverse Transfer Capacitance		Orac	C _{rss}	-	Banes	25	
SWITCHING CHARACTERISTICS							
Turn-On Delay Time			t _d (on)	-	-	s 15	ns
Rise Time 08	(V _{DS}	≈ 0.5 V(BR)DSS	t _r	Tan VI	_	25	
Turn-Off Delay Time	ID = 0	2 4 7 50 ())	td(off)	0 = c+		9m15 valo	
Fall Time 08		a.	tf	_	_	15	
SOURCE-DRAIN DIODE CHARACTERIS	STICS			earres			
Diode Forward Voltage (V _{GS} = 0)	$I_S = 0.6 A,$ $I_S = 0.45 A$		VSDIAR	lg = 0.8 A	$(A^{\frac{2}{2}} = 0)$	2.0	Vdc
Continuous Source Current, Body Dio	de	IRFD210 IRFD213	IS GARI	_ ebe	o yhoti ,men	0.6 0.45	Adc
Pulsed Source Current, Body Diode		IRFD210 IRFD213	ISM	_	Body Digde	2.5 1.8	os (Alies
Forward Turn-On Time	(Is = Ra	ated Is, VGS = 0)	ton	Ci	negligible	smiT nO-ms	ns
Reverse Recovery Time		37 - 43 -7	t _{rr}	811	290	eraiT Vi evoos	

120

°C/W

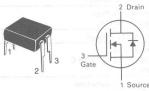
Rating A& BAAO	Symbol	IRFD220	IRFD223	Unit
Drain-Source Voltage	VDSS	200	150	Vdc
Drain-Gate Voltage $(R_{GS} = 20 \text{ k}\Omega)$	V _{DGR}	200	150	Vdc
Gate-Source Voltage	VGS	by ±	20	Vdc
Drain Current Continuous T _C = 25°C Pulsed	I _D	0.8 2.4	0.7 5.6	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	Lifetimen	.0	Watts mW/°C
Operating and Storage Temperature Range	age Temperature Range TJ, T _{Stq} -55 to +15		+ 150	°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Ambient	$R_{\theta}JA$	120	°C/W
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IRFD223

CASE 370-01, STYLE 1



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

tinu Kalvi Charact	eristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						8	0115115	HALL OF \$184
Drain-Source Breakdown Voltage (VGS = 0, I _D = 250 μA)	008	IRFD220 IRFD223		V _{(BR)DSS}	200 150	VAI	veb.inetii 082 <u>- 0</u> 1.	Vdc
Zero Gate Voltage Drain Current (V	OSS = Rate	d V _{DSS} , V _{GS} =	0 V)	IDSS	DSS — Rate	(1 <u>(nam</u> ul) r	250	μAdc
Gate-Body Leakage Current, Forward	(VGSF =	20 V)		IGSSF	- 122V) (ายกา, <u>คิ</u> ยาพลา	500	nAdc
Gate-Body Leakage Current, Reverse	(VGSR =	-20 V)		IGSSR	- 8 20 VI I	runt, <u>R</u> eversi	-500	nAdc
ON CHARACTERISTICS							CLEMPLICE	W CHIEFE
Gate Threshold Voltage (I _D = 250 μA, V _{DS} = V _{GS})	0.5	(#)26 ^V		V _{GS(th)}	2.0	Vesi	4.0	Vdc
Static Drain-Source On-Resistance(1) (VGS = 10 Vdc, I _D = 0.4 A)		IRFD220 IRFD223		rDS(on)	_	Resistence(1 0.3 <u>Au</u>	0.8	Ohms
On-State Drain Current(1) (VGS = 10 V, V _{DS} = 5.0 V)	1.5	IRFD220 IRFD223	0211 0213	ID(on)	0.8 0.7	_ty 0.8	mento : : - gg <u>V</u> ir l	Adc
Forward Transconductance(1) (I _D = 0.4 A, V _{DS} = 5.0 V)	6.6	a10.		9fs	0.5	_U lean- (V:0,)	toet <u>an</u> Ler gebruik	mhos
CAPACITANCE								
Input Capacitance	-	Ciss		Ciss	-		600	pF
Output Capacitance		= 25 V, V _{GS} = = 1.0 MHz)	0	Coss	SGA		300	1 75
Reverse Transfer Capacitance		- 1.0 (4)(12)		C _{rss}		somen	80	d Patrike
SWITCHING CHARACTERISTICS				Luma de la companya della companya della companya della companya de la companya della companya d		201787FE	TOARDED	while affire
Turn-On Delay Time		(ec)6 ¹		td(on)	_	-	40	ns
Rise Time	(VDS	≈ 0.5 V(BR)DSS	8	ediastr 50 -	adV—		60	C. The
Turn-Off Delay Time		0.4 A, $Z_0 = 50 \Omega$		td(off)	0 = Q <u>L</u>		100	u ed m
Fall Time				tf	_	L -	60	annT a
SOURCE-DRAIN DIODE CHARACTER	ISTICS				Saltai		BOOLD NIN	
Diode Forward Voltage (V _{GS} = 0)	Is = 0.8 A, Is = 0.7 A,			V _{SD}	tg = _0.6 A, tg = _0.45 A	(A = 50A)	2.0 1.8	Vdc
Continuous Source Current, Body Did	ode	IRFD220 IRFD223		IS	_ abo	гетг. <u>Во</u> dy О. —	0.8 0.7	Adc
Pulsed Source Current, Body Diode	-	IRFD220 IRFD223		ISM	_	Body_Dinde	6.4 5.6	Α
Forward Turn-On Time	(le = F	lated Is, VGS =	0) (9	an ton	H = 21	negligible	em Infr	ns
Reverse Recovery Time	1.3	37 - 43	-,	t _{rr}		150	arati <u>v</u> jet	12 HORN

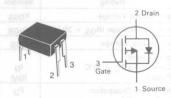
IRFD9120

MAXIMUM RATINGS

Rating	Symbol	IRFD9110	IRFD9112	Unit
Drain-Source Voltage	V _{DSS}	Vdc	- 100 ₍₁₀	Vdc
Drain-Gate Voltage (RGS = 20 k Ω)	VDGR	SeV	-100 _{GB}	Vdc
Gate-Source Voltage	VGS	Vec	±20	Vdc
Drain Current Continuous T _C = 25°C Pulsed	I _D	- 0.7 - 3.0	0.6 4 – 2.5	Adc
Total Power Dissipation $(a T_C = 25^{\circ}C)$ Derate above 25°C	PD	emaw onwm	1.0	Watts mW/°C
Operating and Storage Temperature Range	T _J , T _{stg}	⊙ - 55	to +150	°C
THERMAL CHARACTERISTICS				
Thermal Resistance Junction to Ambient (Free Air Operation)	$R_{\theta JA}$	WOT	120 051	°C/W

IRFD9110 IRFD9112

CASE 370-01, STYLE 1



TMOS FET

P-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

the Koff Charac	cteristic	Symbol		Symbol	Min	Тур	Max	Unit	
OFF CHARACTERISTICS						25	RACTERISTM	AND REC	
Drain-Source Breakdown Voltage (VGS = 0, ID = -250 μA)	001	aed(Ae)V		V(BR)DSS	100	vin Vollage 50 uA)	obsis al a en.	Vdc	
Zero Gate Voltage Drain Current (\	DSS = Rat	ted V _{DSS} , V _{GS}	; = 0 V)	IDSS	Vnec - Rat	in Current	250	μAdc	
Gate-Body Leakage Current, Forwar	d (VGSF =	- 20 V)		IGSSF	- samy) by	awro Tineni	500	nAdc	
Gate-Body Leakage Current, Reverse	e (VGSR =	= 20 V)		IGSSR	gaaVi ev	sever Rever	500	nAdc	
ON CHARACTERISTICS						2	arreneme.	ARD MO	
Gate Threshold Voltage $(I_D = -250 \mu A, V_{DS} = V_{GS})$	2.0	Vesim		V _{GS(th)}	2.0	9) (anV = 2	4.0 oz	Vdc	
Static Drain-Source On-Resistance(1 (VGS = -10 Vdc, ID = -0.3 A))	IRFD9110 IRFD9112		rDS(on)	= (4	n-Resignance	1.2	Ohms	
On-State Drain Current(1) (VGS = 10 V, VDS = -5.0 V)	1.0	IRFD9110 IRFD9112		ID(on)	0.7 0.6	(1)s	Draid Curren	Adc	
Forward Transconductance(1) (I _D = -0.3 A, V _{DS} = -5.0 V)	8.0	alB		9fs	0.6	(Flagnet) = -5.0 V)	Tanasondee	mhos	
CAPACITANCE							ANICE	TEDAL AC	
Input Capacitance		= -25 V, V _{GS} f = 1.0 MHz)	Cue		C _{iss}	-	_	250	pF
Output Capacitance	(V _{DS}		5 = 0	Coss	SGAT	_	100		
Reverse Transfer Capacitance		Cree		C _{rss}	_	enristion	35	sact laf	
SWITCHING CHARACTERISTICS									
Turn-On Delay Time		(riole)		t _d (on)	_	_	30	ns	
Rise Time 001	- (V _D	s ≈ 0.5 V(BR)C	SS,	t _r	Arrive -	-	60	III salf	
Turn-Off Delay Time	ID =	$-0.3 \text{ A, Z}_0 =$	50 Ω)	td(off)	= 0+	_	9m, 40, sisc	MO-mult	
Fall Time				tf		_	40	emil de	
SOURCE-DRAIN DIODE CHARACTE	RISTICS				Sorram	CHARACTE	GOLG VEATO	SID FLU DE	
Diode Forward Voltage (VGS = 0)		7 A, IRFD9110 6 A, IRFD9112		VSD .A	(i – ≡ai i io – ≡ai) = <u>85</u> V) e	-5.5 -5.3	Vdc	
Continuous Source Current, Body D	iode	IRFD9110 IRFD9112		occeds	_aboic	yboa mem	-0.7 -0.6	Adc	
Pulsed Source Current, Body Diode	-	IRFD9110 IRFD9112		ostelsM Estadan	_	t, Bod y Diad	- 3.0 - 2.5	a baAu	
Forward Turn-On Time aldioligan	(ls =	Rated Is, VGS	= 0)	ton	128	negligible	Cum-On Thro	ns	
Reverse Recovery Time	,.0	3, 703	(0)	t _{rr}		120	nil v is voosi	OUTS 78F	

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

IRFD9110 IRFD9112

MAXIMUM RATINGS

Thermal Resistance Junction to Ambient (Free Air Operation)

Rating	Symbol	IRFD9120	IRFD9123	Unit
Drain-Source Voltage	VDSS	100	60 001	Vdc
Drain-Gate Voltage (RGS = 20 k Ω)	VDGR	100	60 901	Vdc
Gate-Source Voltage	VGS	yde	± 20 05 %	Vdc
Drain Current Continuous T _C = 25°C Pulsed	I _D	1.0 8.0	0.8 6.4	Adc (7,0 - 0.8 -
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	ettis W Dr Wres	1.0	***
Operating and Storage Temperature Range	T _J , T _{stg}	- 55	to +150 T + 0	es ∘C
THERMAL CHARACTERISTICS	3.9			

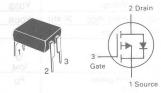
 $\mathsf{R}_{\theta}\mathsf{J}\mathsf{A}$

120

°C/W

IRFD9120 IRFD9123

CASE 370-01, STYLE 1



TMOS FET TRANSISTOR

P-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (To = 25°C unless otherwise noted.) and a seeing J EL and BONTON STANDARAM STAN

Hatt Kall Grand	cteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					31	ALSON LAND	AR PAC
Drain-Source Breakdown Voltage (VGS = 0, ID = -250 μA)	001	IRFD9120 IRFD9123	V _{(BR)DSS}	100 60	eps <u>tlo</u> V on 50 x A <u>J</u>	obsta <u>ns</u> f	Vdc
Zero Gate Voltage Drain Current (\	DSS = Rate	ed V _{DSS} , V _{GS} = 0 V)	IDSS	Voss_ Rat	an Cument	250	μAdc
Gate-Body Leakage Current, Forwar	d (VGSF =	- 20 V)	IGSSF	- 480A) p.	swie-1_triani	500	nAdc
Gate-Body Leakage Current, Reverse	e (VGSR =	20 V) 30	IGSSR	- яарУ) ∋	ment_Heven	500	nAdd
ON CHARACTERISTICS					2	CITHISTIC	- 4-80
Gate Threshold Voltage $(I_D = -250 \mu A, V_{DS} = V_{GS})$	2.0	Maay	VGS(th)	2.0	(20 ^V = 2	4.0	Vdc
Static Drain-Source On-Resistance(1 $(V_{GS} = -10 \text{ Vdc}, I_D = -0.8 \text{ A})$) —	IRFD9120 IRFD9123	rDS(on)	()	n-Res <u>ist</u> ance 0 = <u>-0</u> 3 A)	0.6	Ohms
On-State Drain Current(1) $(V_{GS} = 10 \text{ V}, V_{DS} = -5.0 \text{ V})$	9.0	IRFD9120 IRFD9123	ID(on)	1.0 0.8	(V <u>0</u> 2	er <u>0</u> - 20° →	Adc
Forward Transconductance(1) $(I_D = -0.8 \text{ A, } V_{DS} = -5.0 \text{ V})$	3.0	a)9	9fs	0.8	(V 0.0 = = - 5.0 V)	i jes <u>en</u> oduc 14 A. Zbs.	mhos
CAPACITANCE						300	112 9A
Input Capacitance			Ciss			450	pF
Output Capacitance		$= -25 \text{ V, V}_{GS} = 0$ f = 1.0 MHz)	Coss	80 * [_	350	3500
Reverse Transfer Capacitance		881-2	C _{rss}	_	<u>aa</u> 851108	100	THE Stores
SWITCHING CHARACTERISTICS							34 - 445
Turn-On Delay Time			td(on)	_	_	50	ns
Rise Time		$\approx 0.5 \text{ V}_{(BR)DSS}$	$g(Rg)(t_{r}^{2}.0 -)$	(VD)	_	100	III Ben
Turn-Off Delay Time	-ID = -	$-0.8 \text{ A, } Z_{\text{O}} = 50 \Omega)$	td(off)	: o <u>l</u>	_	100	e min
Fall Time		<u> </u>	t _f		_	100	la la la la la la la la la la la la la l
SOURCE-DRAIN DIODE CHARACTEI	RISTICS			RISTICS	E CHARACTE	dotto 14 mil	- Up
Diode Forward Voltage (VGS = 0)		A, IRFD9120 A, IRFD9123	Offic V _F ²¹ , A s SETECHAL A	18 = -0.1 18 = -0.1) = <u>20</u> V) s	6.3 6.0	Vdc
Continuous Source Current, Body D	iode	IRFD9120 IRFD9123	STEGRA	eooi(Irrent_Body	1.0 0.8	Adc
Pulsed Source Current, Body Diode		IRFD9120 IRFD9123	ISM	_	t, Rod <u>v</u> Died	8.0 6.4	А
Forward Turn-On Time eldigilgen	(Is =	Rated Is, VGS = 0)	ton	= all	negligible	mit no nu	ns
Reverse Recovery Time		37 43	t _{rr}	_	150	nif y <u>w</u> ysiu	H's avail

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

THERMAL CHARACTERISTICS

MAXIMON HATINGS					
Rating		Symbol	IRFE110	IRFE113	Unit
Drain-Source Voltage	Orain-Source Voltage		100	60	Vdc
Drain-Gate Voltage (RGS	= 20 kΩ)	V _{DGR}	100	60	Vdc
Gate-Source Voltage	May	VGS	Vdc	±20 05 =	Vdc
Drain Current Continuous T _C = 25°C Pulsed		I _D	1.0 8.0	8 0.8 6.4	Adc
Total Power Dissipation @ T _C = 25°C	Package	PD	Watts mw/c	3.0	Watts mW/°C
Derate above 25°C Per Device				1.0 0.1 8.0 0.8	Watt mW/°C
Operating and Storage Temperature Range		T _J , T _{stg}	- 55	to +150 at + of	ea °C∵

IRFE110 IRFE113

CASE 648-06



QUAD TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

Thermal Resistance Junction to R_{θJA} 40 Total Package Ambient (Free Air Operation) 125 Each FET

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Charac	teristic	les-female		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS EACH FET	19000					THE RELATED	STREETSA	BARO TEO
Drain-Source Breakdown Voltage (VGS = 0, ID = 250 μA)	100	IRFE110 IRFE113		V(BR)DSS	100 60	egalloV m	robites 8 restdor	Vdc
Zero Gate Voltage Drain Current (V	DSS = Rate	ed V _{DSS} , V _{GS} =	0 V)	IDSS	0 - 12 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	the transition	250	μAdc
Gate-Body Leakage Current, Forward	d (VGSF =	20 V)		IGSSF		Support Trans	500	nAdc
Gate-Body Leakage Current, Reverse	(VGSR =	-20 V)		IGSSR	100/1	ansavaši tasv	500	nAdc
ON CHARACTERISTICS EACH FET		No. No.			1100	773 675 6	enreserin.	SILVER NE
Gate Threshold Voltage (ID = 250)	μA, V _{DS} =	V _{GS})		VGS(th)	2.0		4.0	Vdc
Static Drain-Source On-Resistance(1) (VGS = 10 Vdc, I _D = 0.8 A))	IRFE110 IRFE113		rDS(on)		(1)eoneTelsell	0.6 0.8	Ohms
On-State Drain Current(1) (VGS = 10 V, VDS = 5.0 V)	1.0	IRFE110 IRFE113		¹ D(on)	1.0 0.8	(F)	tain Curters	Adc
Forward Transconductance(1) (I _D = 0.8 A, V _{DS} = 5.0 V)	8.0	Ste		9fs	0.8	(F)eoni	toubnosaru	mhos
CAPACITANCE EACH FET			-			14	A HOAR ROW	STEMASS
Input Capacitance				Ciss			200	pF
Output Capacitance		$= 25 \text{ V, V}_{GS} = 0$ f = 1.0 MHz	0 =	Coss	-Sd\ /-	-	100	and browning
Reverse Transfer Capacitance		1.0.111127		C _{rss}	_	anasa	25	T serveys
SWITCHING CHARACTERISTICS EAC	CH FET	1 8817				TAN POPUNIS	PO CHARACO	DAINE THAT
Turn-On Delay Time				td(on)	-	-	20	ns
Rise Time	(V _{DS}	≈ 0.5 V(BR)DSS		tr		_	25	smill sa
Turn-Off Delay Time	ID =	$0.8 \text{ A, } Z_0 = 50 \Omega)$	102-0	td(off)	= <u>all</u>	_	25	1 rome
Fall Time		Anthrop		tf	_	_	20	amul time
SOURCE-DRAIN DIODE CHARACTER	ISTICS EAC	H FET		7304	DAN POUR	CHARACTER	anoid MUS	D-HORNE
Diode Forward Voltage (V _{GS} = 0)	$I_S = 1.0 A$ $I_S = 0.8 A$		11 10 10 10	OCIVE AND A	ls =1.0	(v = <u>B</u> pv)	2.5 2.0	Vdc
Continuous Source Current, Body Di	ode	IRFE110 IRFE113		021083911	_ spe	rant, Body Ok	1.0	Adc
Pulsed Source Current, Body Diode		IRFE110 IRFE113		ISM	_	Stoil Vacas	8.0 6.4	A
Forward Turn-On Time	(c =	Rated Is, VGS = 0	0)	ton		negligible	emil nilens	ns
Reverse Recovery Time	,,0	.57.03	10 =	Sov trr	1 = 80	100		E arms

°C/W

Rating	2AO	Symbol	IRFE9120	IRFE9123	Unit
Drain-Source Voltage		VDSS	100	60	Vdc
Drain-Gate Voltage (RGS	= 20 kΩ)	VDGR	100	60	Vdc
Gate-Source Voltage	Distance.	VGS	obV ±	20	Vdc
Drain Current Continuous T _C = 25°C Pulsed		I _D	1.0	8 0.8 6.4	Adc
Total Power Dissipation @ T _C = 25°C			3.0 30 30		Watts mW/°C
Derate above 25°C	Per Device			.0 0.0	Watt mW/°C
Operating and Storage Temperature Range		T _J , T _{stg}	— 55 to	+ 150	°C °C
THERMAL CHARACTER	ISTICS	1.05			
Thermal Resistance Junction to Ambient (Free Air Operation)		$R_{\theta JA}$		Package ich FET	°C/W

IRFE9120 IRFE9123

CASE 648-06



QUAD **TMOS FET TRANSISTOR**

P-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS EACH FET					THE PLANT OF	IT CAPILLY	APPO 12
Drain-Source Breakdown Voltage (VGS = 0, ID = -250 μA)	08	IRFE9120 IRFE9123	V _{(BR)DSS}	100 60	eganov man	185	Vdc
Zero Gate Voltage Drain Current (\	DSS = Rate	ed V _{DSS} , V _{GS} = 0 V)	IDSS	280 - S80) marrus n	250	μAdc
Gate-Body Leakage Current, Forwar	d (VGSF =	20 V)	IGSSF	= 485 A) c	NRW161 (Inst)	500	nAdd
Gate-Body Leakage Current, Reverse	(VGSR =	-20 V)	IGSSR	- HSSA1 -	steven areas	500	nAdd
ON CHARACTERISTICS EACH FET	as as de access				FOR HUNDE	THE PERSON	125/12/30
Gate Threshold Voltage $(I_D = -25)$	0 μA, VDS	= V _{GS})	VGS(th)	2.0	002 - GH	4.0	Vdc
Static Drain-Source On-Resistance(1 $(V_{GS} = -10 \text{ Vdc}, I_{D} = -0.8 \text{ A})$)	IRFE9120 IRFE9123	rDS(on)	=	(A 8.0	0.6 0.8	Ohms
On-State Drain Current(1) (VGS = -10 V, VDS = 5.0 V)	8.0	IRFE9120 IRFE9123	ID(on)	1.0 0.8	V 0.8	6717 1 127	Adc
Forward Transconductance(1) (I _D = -0.8 A, V _{DS} = 5.0 V)	8.0	新	9fs	0.8	(V:0 e	- 5 <u>0</u>	mhos
CAPACITANCE EACH FET					1.3%	PORT	LEGINGE
Input Capacitance	- ast ² 0	Ciss	anVI		450	pF	
Output Capacitance		$= -25 \text{ V, V}_{GS} = 0$ f = 1.0 MHz	Coss	_		350	J Took
Reverse Transfer Capacitance		8818	C _{rss}	_		100	1 B215V
SWITCHING CHARACTERISTICS EA	CH FET			139 11	ARCH SUR LOURS	QAZ-10-	1141-114
Turn-On Delay Time		(na)b?	td(on)	_		50	ns
Rise Time	(V _{DS}	≈ 0.5 V(BR)DSS,	BIO(HB)tr d.o.	Sd _A)_		100	antil oz
Turn-Off Delay Time	1 _D = -	$-0.8 \text{ A}, Z_0 = 50 \Omega)$	td(off)			100	-
Fall Time		1,	tf			100	anist it
SOURCE-DRAIN DIODE CHARACTER	RISTICS EAC	H FET	131 8	SUMS SULLS	HEIDANAMU S	THE PROPERTY	CE TOPE OF
Diode Forward Voltage (VGS = 0)		A, IRFE9120 A, IRFE9123	VF 34A	V 8'0 = St	(s = S ^D A)	6.3 6.0	Vdc
Continuous Source Current, Body D	iode	IRFE9120 IRFE9123	e ^l S ₃₄₉₁	_ 600	u yooy u	1.0 0.8	Adc
Pulsed Source Current, Body Diode		IRFE9120 IRFE9123	ISM		Budy Diage	8.0 6.4	Α
Forward Turn-On Time	(le = F	Rated Is, VGS = 0)	- an ton	4 = 2()	negligible	mini garan	ns
Reverse Recovery Time	1.9	13/ 143 0/	t _{rr}		150	THE PERSON NAMED IN	-i petav

(1) Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

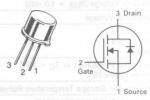
MAXIMOM NATINGO				
Rating	Symbol	IRFF110	IRFF113	Unit
Drain-Source Voltage	VDSS	100	60	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	100	60	Vdc
Gate-Source Voltage	VGS	w ±	20	Vdc
Drain Current Continuous Pulsed	I _D	3.5 o.	3.0	Adc
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	0.50	5 oc 12 ar.o	Watts W/°C
Operating and Storage Temperature Range	TJ, Tsta	- 55	to 150	°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	$R_{\theta JC}$	8.33	°C/W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	175	°C/W
Maximum Lead Temperature	TL	300	°C

IRFF113

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET
TRANSISTOR
N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

sints new city Ch	aracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS			COTERISTICS	OFF CHAR			
Drain-Source Breakdown Voltage (VGS = 0, ID = 250 μA)	Reginer	IBFF120 (BFF123	IRFF110 IRFF113	V(BR)DSS	100 60	e Bre st down	Vdc
Zero Gate Voltage Drain Current (VDS	= Rated V	DSS, VGS = 0)	(0 = apV a	IDSS	Gunerit (Vb)	250	μAdc
Gate-Body Leakage Current, Forward	(VGS = 20	Vdc, V _{DS} = 0)	(0 = zav.)	GSSF	int. F or ward	100	nAdc
Gate-Body Leakage Current, Reverse	$V_{GS} = -2$	0 Vdc, V _{DS} = 0)	(0 - 20V o	IGSSR	eant, fluvorse	- 100	nAdc
ON CHARACTERISTICS*						CTERISTICS*	ARAHO MC
Gate Threshold Voltage (VDS = VGS	I _D = 250 μ	(A)		VGS(th)	2.0	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 1.5 Adc)	(ma)80°	INFE120 INFE123	IRFF110 IRFF113	rDS(on)	esist un ce 5.0 A du)	0.6	Ohm
On-State Drain Current (VGS = 10 Vdc, VDS = 15 V)	(no)Cl	IRFF120 IRFF123	IRFF110 IRFF113	I _{D(on)}	3.5 3.0 V a	tner u O nie = 2 01 V U	Α
Forward Transconductance (I _D = 1.5 A, V _{DS} = 15 V)				9fs A	0.8 1.0	ns co nd uctat	mhos
DYNAMIC CHARACTERISTICS					8200	HARACTERIS	OVER THE C
Input Capacitance	Ciss			Ciss	_	200	gg pF
Output Capacitance	Coss	$(V_{DS} = 25 \text{ V}, V_{G})$	S = 0, as	Coss	_	100	
Reverse Transfer Capacitance	Cess	T = 1.0 WITZ	Active U. F = 1	C _{rss}	—som	25	
SWITCHING CHARACTERISTICS*					+2OFF3F	ETSARAHS :	Met07m/k
Turn-On Delay Time	(no)b)			td(on)	_	20 Tys	ns
Rise Time	47	(V _{DD} ≈ 0.5 Rated	VDSS, and and	tr	-	25	
Turn-Off Delay Time	(fig)b)	$R_{\text{gen}} = 50 \text{ oh}$	ms) 08 = gt Mgen = 50 (sm	td(off)	_	25 T yes	
Fall Time OT -	10	gon	Half.	tf	_	20	
SOURCE-DRAIN DIODE CHARACTERIS	STICS*			*20iTe	HARACTER	NAME DECIDE	IO ROBUO
Forward On-Voltage	Vsp	IRFF110	JREF120	V _{SD}	_	2.5	Vdc
- 2.3 Vdc	Vsp	IRFF113		V _{SD}	-	2.0	Vdc
Forward Turn-On Time	not	(Is = Rated ID	on), belas = gi)	ton	_	Negligible	of uns
Reverse Recovery Time	22)		$V_{GS} = 0$		_	200 (Typ)	ns

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

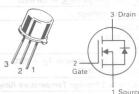
Rating	Symbol	IRFF120	IRFF123	Unit
Drain-Source Voltage	VDSS	100	60	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	100	60	Vdc
Gate-Source Voltage	VGS	₩ ±	20	Vdc
Drain Current Continuous Pulsed	I _D	6.0 24	5.0	Adc
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD		20 16	Watts W/°C
Operating and Storage Temperature Range	TJ, Tstg	- 55	to 150	°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	R _O JC	6.25	°C/W
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	175	°C/W
Maximum Lead Temperature	TL	300 808	°C

IRFF120 IRFF123

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

ELECTRICAL CHARACTERISTICS (TC = 25°C unless otherwise noted.) The control of the

Med Kald Characteristic				Min	Max	Unit
OFF CHARACTERISTICS					SOMETHER	1 ALIO 170
Drain-Source Breakdown Voltage (VGS = 0, ID = 250 μA)	Sed(se)A	IRFF120 IRFF123	V _{(BR)DSS}	100 60	ewob <u>dead</u> fow e lg: <u>L</u> 85st pr	Vdc
Zero Gate Voltage Drain Current (VDS	S = Rated V	DSS, VGS = 0) (0 # 28V &	IDSS	gVi t <u>m</u> emuð	250	μAdc
Gate-Body Leakage Current, Forward	(VGS = 20	Vdc, V _{DS} = 0) 10 = 20V kg	IGSSF	int, F <u>ar</u> ward	100	nAdc
Gate-Body Leakage Current, Reverse	(VGS = 20 \	/dc, V _{DS} = 0) (0 = agV ab	IGSSR	ent, R <u>av</u> erse	-100	nAdc
ON CHARACTERISTICS*					CTERISTICS*	FIRST NO
Gate Threshold Voltage (VDS = VGS	, I _D = 250 μ	A)	VGS(th)	2.030	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, I _D = 3.0 Adc)	(no)2(1)	IRFF120 IRFF123	rDS(on)	esist <u>an</u> ge .5 Ad <u>c</u>)	0.3	Ohm
On-State Drain Current (VGS = 10 V, VDS = 15 V)	(ao)G ^l	IRFF120 IRFF123	I _{D(on)}	6.0 5.0	advilla	Α
Forward Transconductance (I _D = 3.0 A, V _{DS} = 15 V)				1.5	remphaorere	mhos
DYNAMIC CHARACTERISTICS				77505	SIMELESVINAL	DETAMAGE
Input Capacitance	Class		Ciss	_	600	pF
Output Capacitance	SaoD	$(V_{DS} = 25 \text{ V}, V_{GS} = 0,$ f = 1.0 MHz)	Coss	_	400	
Reverse Transfer Capacitance	Orss	1 - 1.0 141127	C _{rss}	3002	100	
SWITCHING CHARACTERISTICS*				remes*	RETOARANO :	SWALCHIS
Turn-On Delay Time	(no)bf		t _{d(on)}	_	40	ns
Rise Time	14.	$(V_{DD} \approx 0.5 \text{ Rated } V_{DSS})$	tr		70	
Turn-Off Delay Time	Molbi	I _D = 3.0 A, R _{gen} = 50 ohms)	td(off)		100	
Fall Time OS	71	gen	tf	_	70	
SOURCE-DRAIN DIODE CHARACTERI	STICS*		*2017	HARACTER	STANK MODE C	4+ DAUGA
Forward On-Voltage	OgV.	IRFF120	VSD	_	2.5	Vdc
2.0 Vdc	gaV	IRFF123	V _{SD}		2.3	Vdc
Forward Turn-On Time	not	(Is = Rated Ip(on),	ton		Negligible	ns
Reverse Recovery Time	125	V _{GS} = 0)	t _{rr}	_	200 (Typ)	ns

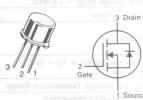
^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

Rating of TRAC	Symbol	IRFF210	IRFF213	Unit
Drain-Source Voltage 37 98-07	VDSS	200	150	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	200	150	Vdc
Gate-Source Voltage	, V _G S	bV ±	20 03	Vdc
Drain Current Continuous Pulsed	I _D	2.2 9.0	1.8 7.5	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	1 1	15 0S 0.12 81.0		Watts W/°C
Operating and Storage Temperature Range	TJ, Tstq	-55 to 150		°C

Thermal Resistance Junction to Case	R _θ JC	8.33	°C/W
Thermal Resistance Junction to Ambient	R ₀ JA	175	°C/W
Maximum Lead Temperature 1.6 mm from Case for 10 s	TL	300 008	°C

IRFF210 IRFF213

CASE 79-03 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

tiet. KEM nit/l Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					#OTER(STREE	CHARA
Drain-Source Breakdown Voltage $(V_{GS} = 0, I_D = 250 \mu A)$	\$\$0(88)V	IRFF210 IRFF213	V(BR)DSS	200 150	з Вго <u>да</u> форо). ID ≈_280 до	Vdc
Zero Gate Voltage Drain Current (VDS	= Rated V _{DS}	s, V _{GS} = 0) 10 = 20	IDSS	ante <u>at</u> (Vige	250	μAdc
Gate-Body Leakage Current, Forward	(VGS = 20 Vd	c, V _{DS} = 0)	IGSSF	st, Foowerd	100	nAdc
Gate-Body Leakage Current, Reverse	$V_{GS} = -20 V$	(dc, V _{DS} = 0) (0 = adV	IGSSR	n, Regerse	-100	nAdc
ON CHARACTERISTICS*					CTERNSTICS*	CRARRA
Gate Threshold Voltage (VDS = VGS,	$I_D = 250 \mu A)$		V _{GS(th)}	2.0	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 1.25 A)	(no)301	IRFF210 IRFF213	rDS(on)	sista <u>ur</u> o 0 Ad <u>ril</u>	1.5 2.4	Ohm
Forward Transconductance (ID = 1.25	A, VDS = 5.0	IRFF220 (V	9fs	0.8	ain Ci <u>m</u> ent	mhos
DYNAMIC CHARACTERISTICS		235799		130 V 0:0	4 SGA DEATH	65)
Input Capacitance	818		C _{iss}	A.2 On a	150	pF
Output Capacitance		$f_{DS} = 25 \text{ V}, V_{GS} = 0,$ f = 1.0 MHz	Coss	t-ot	80	
Reverse Transfer Capacitance	8810	= 25 V. Vec = 0.	Crss		25	
SWITCHING CHARACTERISTICS*	8899	(sHMz) = 1.0 MHz)			POURTURE	Qual IIII
Turn-On Delay Time	8817		t _{d(on)}	938	15	ns
Rise Time		DD = 0.5 Rated VDSS,	tr	Touri o	25	
Turn-Off Delay Time	(no)b ³	$I_D = 1.25 \text{ A},$ $R_{gen} = 50 \text{ ohms})$	t _d (off)	_	15	
Fall Time	2	A 0.5 = gl	tf	_	15	
SOURCE-DRAIN DIODE CHARACTERIS	STICS*	ismino 02 = 80	A .		ment yet	e nuon
Forward On-Voltage	7	IRFF210	V _{SD}		2.0	Vdc
		IRFF213	V _{SD}	IND I VANK	1.8	Vdc
Forward Turn-On Time	QS/V	(Ic = Rated Inton).	ton	-	Negligible	ns
Reverse Recovery Time	GS.A.	$V_{GS} = 0$			200 (Typ)	ns

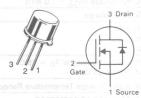
Rating	Symbol	IRFF220	IRFF223	Unit
Drain-Source Voltage	VDSS	200	150	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR	200	150	Vdc
Gate-Source Voltage	VGS	ev ±	20 00 -	Vdc
Drain Current Continuous Pulsed	I _D	3.5 14	3.0	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	COCKE, L	20 16 srg	Watts W/°C
Operating and Storage Temperature Range	T _J , T _{stg}	-55	to 150	°C
THERMAL CHARACTERISTICS				
Thermal Resistance Junction to Case	R _θ JC ⋅	6.	25	°C/W

 $R_{\theta JA}$

TL

IRFF220 IRFF223

CASE 79-03, STYLE 6 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL --- ENHANCEMENT

ELECTRICAL CHARACTERISTICS ($T_C = 25^{\circ}C$ unless otherwise noted.)

Thermal Resistance Junction to Ambient

Maximum Lead Temperature

ELLOTHIOAL OHAHAOTEHIOTIOO	116 200 0111	C33 Other Wise I	Otodi,		A SPACEL TO STREET BANK		
rinu xuM nifti Cl	haracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS							O RO 490
Drain-Source Breakdown Voltage (VGS = 0, ID = 250 μA)	sed(sa)V	IRFF210 IRFF213	IRFF220 IRFF223	V _{(BR)DSS}	200 150	nwot at ens e Au Ge s - o	Vdc
Zero Gate Voltage Drain Current (VD	S = Rated V _{DS}	s, VGS = 0)	(0 = 25V s	IDSS	zaV) m emi	250	μAdc
Gate-Body Leakage Current, Forward	(VGS = 20 Vd	c, $V_{DS} = 0$)	(0 = priV.)	IGSSF	nt, Farward	100	nAdc
Gate-Body Leakage Current, Reverse	$(V_{GS} = -20 V$	(dc, V _{DS} = 0)	10. Vns. = 01	IGSSR	neteval in	-100	nAdc
ON CHARACTERISTICS*						*ZanTemano	SULAHO M
Gate Threshold Voltage (VDS = VGS	$I_D = 250 \mu A$			VGS(th)	2.0	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 2.0 Adc)	msiam.	IRESPIO IRESPIS	IRFF220 IRFF223	rDS(on)	sistance 25 A T	0.8	Ohm
On-State Drain Current (VGS = 10 Vdc, VDS = 5.0 Vdc)	etR		IRFF220 IRFF223	ID(on) A	3.5	netou ol lo:«n	A
Forward Transconductance (I _D = 2.0	A, $V_{DS} = 5.0$	V)		9fs	1.5	-	mhos
DYNAMIC CHARACTERISTICS	200	j0	os - 25 V. Vos	V)			-
Input Capacitance	8800	t = 1.0 MHz)		Ciss		600	pF
Output Capacitance	383- (/	$f = 25 \text{ V, V}_{G}$ f = 1.0 MHz		Coss	450000	300	
Reverse Transfer Capacitance		1 - 1.0 141112	-/	C _{rss}		80	
SWITCHING CHARACTERISTICS*	10000	pani	on - 0.5 Rated V	aV).			
Turn-On Delay Time			ID - 1.28 A.	td(on)	_	40	ns
Rise Time	(VDI		(BR)DSS,	t _r	_	60	
Turn-Off Delay Time	1 2	$I_D = 2.0 A_0$ $R_{gen} = 50 \text{ oh}$		td(off)	and the control of the control	100	
Fall Time	1	gen	2002200	tf		60	
SOURCE-DRAIN DIODE CHARACTER	ISTICS*		0.00000			083712	1 0700010
Forward On-Voltage	Cav	IRFF220	- 1-4-1-4-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-	V _{SD}	_	2.0	Vdc
er acrigitizari	no?	IRFF223	(lg = Rated Ipto	V _{SD}	_	1.8	Vdc
Forward Turn-On Time		(IS = Rated ID	(on),	ton	-0.0	Negligible	ns
Reverse Recovery Time		$V_{GS} = 0$		t _{rr}	the lest one	350 (Typ)	ns

300

°C/W

°C

^{*}Pulse Test: Pulse Width \leq 300 $\mu\text{s},$ Duty Cycle \leq 2.0%.

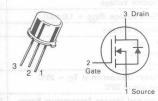
Rating	Symbol	IRFF230	IRFF233	Unit
Drain-Source Voltage	VDSS	200	150	Vdc
Drain-Gate Voltage (RGS = 1.0 mΩ)	VDGR	200	150	Vdc
Gate-Source Voltage	VGS	± 20		Vdc
Drain Current Continuous Pulsed	I _D	5.5 22	4.5 18	Adc
Total Power Dissipation (a T _C = 25°C Derate above 25°C	PD	25 ac 0.2 g o		Watts W/°C
Operating and Storage Temperature Range	TJ, Tstg	-55 to 150		°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	R _θ JC	5.0	°C/W
Maximum Lead Temperature	TL	300 008	°C

IRFF230 IRFF233

CASE 79-03 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

not xam one Ch	aracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS						CTERISTICS	ARAHO T
Drain-Source Breakdown Voltage (VGS = 0, I _D = 250 μA)	Vierioss	18FF320	IRFF230 IRFF233	V(BR)DSS	200 150	e Bre el dowd ip – 250 µ	Vdc.
Zero Gate Voltage Drain Current (VDS	= Rated V	oss, VGS = 0)	(0 = anV a	IDSS	agyl no mu0	250	μAdc
Gate-Body Leakage Current, Forward	(VGS = 20 \	$/dc, V_{DS} = 0)$	0 - POV o	IGSSF	hasw ol Jac	100	nAdc
Gate-Body Leakage Current, Reverse	$V_{GS} = -20$	Vdc, V _{DS} = 0)	(da, Vas = 0)	IGSSR	int, floregraph	-100	nAdc
ON CHARACTERISTICS*						*SOMETHES*	MINAHO V
Gate Threshold Voltage (VDS = VGS,	I _D = 250 μ	A)		VGS(th)	2.0	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, ID = 3.0 A)	(no)8(3)	IRFF330 IRFF333	IRFF230 IRFF233	rDS(on)	esistence 0 Auto	0.4	Ohm
Forward Transconductance (ID = 3.0	A, $V_{DS} = 5$.	0 V) 022334		9fs	2.5	Inst te O nis	mhos
DYNAMIC CHARACTERISTICS					(V.0	0 V. Vos = 5	
Input Capacitance	elt	(V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)		Ciss	os (l <u>p.</u> = 2:0 /	800	pF
Output Capacitance				Coss	aon	450	
Reverse Transfer Capacitance	Ciss	1 = 1.0 ((11)2)		C _{rss}		150	ser Capac
SWITCHING CHARACTERISTICS*	Coss		different to the second			acitance	qe2 lettit
Turn-On Delay Time	Cras			td(on)	6006	30	ns
Rise Time		(V _{DD} = 90 V, I _D =	3.0 A,	t _r	*20178K	50	
Turn-Off Delay Time	[molb ³	Rgen = 50 ohn	ns)	td(off)		50	
Fall Time	1			V) t _f		40	gin) Tex
SOURCE-DRAIN DIODE CHARACTERIS	STICS*	(av	His Od = negh			amit yal	ad Burt
Forward On-Voltage	12	IRFF230		V _{SD}		2.0	Vdc
		IRFF233		V _{SD}	HAR <u>ac</u> teris	1.8	Vdc
Forward Turn-On Time	_ds _A	(Is = Rated Ip(on),	ton	_	Negligible	ns
Reverse Recovery Time	dsV	$V_{GS} = 0$	REFJOR	t _{rr}		450 (Typ)	ns
Pulse Test: Pulse Width ≤ 300 μs, Dur	y Cycle ≤ 2.	0%.	ilig = Rated Ipg Vgg = 6i		an Endovidence	m-On Time overy Time	

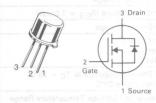
Rating Page 1	Symbol	IRFF330	IRFF333	Unit
Drain-Source Voltage	VDSS	400	350	Vdc
Drain-Gate Voltage (RGS = 1.0 mΩ)	VDGR	400	350	Vdc
Gate-Source Voltage	VGS	± 20		Vdc
Drain Current Continuous Pulsed	I _D	3.5 14	3.0	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD	25 0.2		Watts W/°C
Operating and Storage Temperature Range	TJ, Tstg	-55 to 150		°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Case	R _θ JC	5.0 0.0	°C/W
Maximum Lead Temperature	TL	300	°C
1.6 mm from Case for 10 s			

11/11 1 222

CASE 79-03 TO-39 (TO-205AF)



TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

ELECTRICAL CHARACTERISTICS (C = 25°C unless otherwise noted.)
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zinU xeW nith Ch	naracteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS						201121731734	N/ HO FR
Drain-Source Breakdown Voltage (VGS = 0, I _D = 250 μA)	Pad(aa)V	IRFF236 IRFF233	IRFF330 IRFF333	V _{(BR)DSS}	400 350	t. 1 <u>-ak</u> trown - 11) <u>- 250 p</u>	Vdc
Zero Gate Voltage Drain Current (VD	S = Rated VDS	$S, V_{GS} = 0)$	Vas = 0)	IDSS	Current (Vgr	250	μAdc
Gate-Body Leakage Current, Forward	(VGS = 20 Vdc	$v, V_{DS} = 0)$	Vps = 0)	GSSF	ent, F <u>or</u> ward	100	nAdc
Gate-Body Leakage Current, Reverse	$(V_{GS} = -20 \text{ V})$	$dc, V_{DS} = 0)$		IGSSR	ant, Reverse	100	nAdc
ON CHARACTERISTICS*							
Gate Threshold Voltage (VDS = VGS	$I_D = 250 \mu A$			VGS(th)	2.080V	4.0	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, I _D = 2.0 Adc)	(DS(on)	IRFF230	IRFF330 IRFF333	rDS(on)	esistance 3.0 A)	1.0	Ohm
On-State Drain Current (VGS = 10 V, VDS = 5.0 V)	916		IRFF330 IRFF333	ID(on)	3.5	MEDU <u>A</u> LATU	A
Forward Transconductance (I _D = 2.0 A, V _{DS} = 5.0 V)				9fs	2.0		mhos
DYNAMIC CHARACTERISTICS	Coses	,0 =		g¥)		\$5,411.05	
Input Capacitance	Cres		(With Cit -)	Ciss	- sone	900	pF
Output Capacitance	(V	$DS = 25 \text{ V, V}_{G}$ f = 1.0 MHz		Coss	*aprilar	300	
Reverse Transfer Capacitance	Institut			C _{rss}	_	80	J. IU-mi
SWITCHING CHARACTERISTICS*	- 1	408	- va v. no h	enV)			
Turn-On Delay Time	(Holb)			td(on)	_	30	ns
Rise Time	The state of the s	D = 175 V, ID	= 2.0 A,	t _r	-	35	
Turn-Off Delay Time		$R_{gen} = 50 \text{ oh}$	ms)	td(off)	BETTER	55	
Fall Time	Mags		1865230	tf	_	35	d paragraph
SOURCE-DRAIN DIODE CHARACTER	ISTICS*	1706: 4.7	IAFF233	261	- 1		
Forward On-Voltage	not	IRFF330		V _{SD}	_	1.6	Vdc
an (gyT) 080	717	IRFF333		V _{SD}	_	1.5	Vdc
Forward Turn-On Time		(Is = Rated ID	(on),	a os ton vo v	900 ma, Du	Negligible	ns
Reverse Recovery Time		$V_{GS} = 0$		t _{rr}	_	600 (Typ)	ns

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

1107, 1108 1109, 1110

MAXIMUM RATINGS

Rating	Symbol	IRFF430	IRFF433	Unit
Drain-Source Voltage	VDSS	500	450	Vdc
Drain-Gate Voltage (RGS = 1.0 m Ω)	VDGR 500		450	Vdc
Gate-Source Voltage	VGS	±	20	Vdc
Drain Current Continuous Pulsed	I _D	2.75	2.25 9.0	Adc
Total Power Dissipation @ T _C = 25°C Derate above 25°C	PD		.2 88	Watts W/°C
Operating and Storage Temperature Range	ng and Storage Temperature Range TJ, T _{stq} -55 to 150		to 150	°C

THERMAL CHARACTERISTICS

THERIVIAL CHARACTERISTICS			
Thermal Resistance Junction to Case	$R_{\theta JC}$	5.0	°C/W
Maximum Lead Temperature	TL	300	°C

IRFF430 IRFF433

CASE 79-03 TO-39 (TO-205AF)





TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

ELECTRICAL CHARACTERISTICS ($T_C = 25^{\circ}C$ unless otherwise noted.)

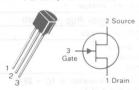
Charac	teristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Lodmy2		oliminatos	Chai		
Drain-Source Breakdown Voltage (VGS = 0, I _D = 250 μA)	29:3(SR)V	IRFF430 IRFF433	V(BR)DSS	500 450	CTERSONS Benefitown	Vdc
Zero Gate Voltage Drain Current (VDS =	Rated V _{DSS} , V ₀	GS = 0	IDSS	_/obA	250	μAdc
Gate-Body Leakage Current, Forward (VG	IGSSF	_	100	nAdc		
Gate-Body Leakage Current, Reverse (VGS = -20 Vdc, VDS = 0)					- 100	nAdc
ON CHARACTERISTICS*	Vancous			60	attoy Matella	10 P 00
Gate Threshold Voltage (VDS = VGS, ID	= 250 μA)	7010	V _{GS(th)}	2.0	= (4.00\/ 8	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, I _D = 1.5 Adc)		IRFF430 IRFF433	rDS(on)	_	1.5 2.0	Ohm
On-State Drain Current (VGS = 10 Vdc, VDS = 5.0 V)		IRFF430 IRFF433	I _{D(on)}	2.75 2.25	стемвтю	ALAMA ME
Forward Transconductance (V _{DS} = 5.0 V	9fs	1.5	niero epsiov	mhos		
DYNAMIC CHARACTERISTICS		BOTL			251.10	100
Input Capacitance — 00		207L	Ciss	_	800	pF
Output Capacitance		= 25 V, V _{GS} = 0, = 1.0 MHz)	Coss		200	
Reverse Transfer Capacitance	(no)201	TOTAL	C _{rss}	- 62 1	60	
SWITCHING CHARACTERISTICS*	1	agru				
Turn-On Delay Time		(B) (C	t _d (on)	_	30	ns
Rise Time	(V _{DD} ≃	$(V_{DD} \approx 225 \text{ V}, I_{D} = 1.5 \text{ A},$	t _r	NAME OF TAXABLE PARTY.	30	
Turn-Off Delay Time	Rge	en = 50 ohms)	t _d (off)		55	
Fall Time	(no)gb ^o		t _f (sell	40.7=1.0	30	
SOURCE-DRAIN DIODE CHARACTERISTIC	S* (maying)					
Forward On-Voltage	(Holge ³	IRFF430	V _{SD}		1.4	Vdc
		IRFF433	V _{SD}	= 1/A-01-	1.3	Vdc
Forward Turn-On Time	(Is	= Rated I _{D(on)} ,	ton	- 1 V 01 -	Negligible	ns
Reverse Recovery Time		$V_{GS} = 0$	t _{rr}	Columbia Columbia	800 (Typ)	ns

^{*}Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

3 0/3/0

J107, J108 J109, J110

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET GENERAL-PURPOSE TRANSISTOR

N-CHANNEL - DEPLETION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	- 25	Vdc
Gate-Source Voltage	VGS	− 25	Vdc
Gate Current	IG	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Junction Temperature Range	TJ	135	°C
Storage Channel Temperature Range	T _{stq}	-65 to +150	°C

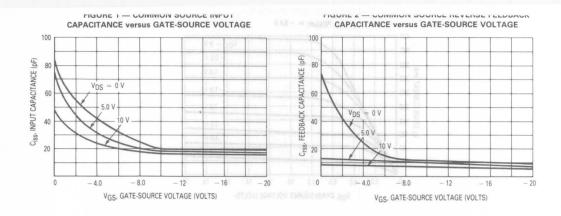
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

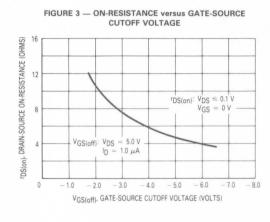
	Characteristic				Min	Typ	Max	Unit
OFF CHAR	ACTERISTICS	Vanishes 500	(45.5430			iown Voltage	o established	Lu Britain Sur
	ce Breakdown Volta 0, I _G = -10 μAdc	0	(RPP433	V(BR)GSS	-25	io _{IAA} <u>.</u> Fain Current	Sok 0	Vdc
Gate Rever		- nasal	10 -	IGSS =		Consnt, For	ap teal	nAdc
$(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0, T_{A} = 0)$			(0 = 8	= - 20 Vitc. Vig	29VI serie	west Instru	-3.0 -200	And a second
Gate Source	ce Cutoff Voltage			VGS(off)		*80	13/81/	Vdc
(VDS =	15 Vdc, ID = 10 nA	Adc) (abA	J107	250 µA)	-0.5	= antil aus	-4.5	E1581
			J108 J109		-3.0 -2.0	Do-Resistan	- 10 - 6.0	Smith. i a
			J110		-0.5	= 115 Add	-4.0	- 0V
ON CHAR	ACTERISTICS	falen)	DEDATA			(V 0.8 = 20	V _ bv ut	- 3%
Zava Cata	Valtage Drain Com	am#/1)		1		-		A -I -

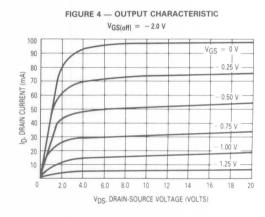
UN CHARAC	TENISTICS	BEDGGG.			V = 5.0 V	V bV 1	3.0
Zero-Gate-Voltage Drain Current(1) (VDS = 15, VGS = 0)		J107	A DSS	100	agVI soneti	ubrana (# -)	mAdc
		J108		80	SOFT SEAS	FRARABA.	
30 008		J109		40	_	Dates to le	
	0 J110/ V Bg	= ea(V)	10	_			
Drain-Source On-Resistance		 ISHM 0.1 =	rDS(on)		-		ohms
$(V_{DS} < 0.1)$	$V, V_{GS} = 0 V)$	J107	50(011)		eamstuss	8.0	
		J108		_	BOIT WELL	8.0	
		J109		_	_	12	
		J110		_	_	18	

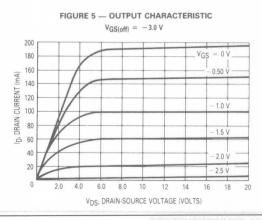
	J110			_	18	
SMALL-SIGNAL CHARACTERISTICS	225 V, ID = 1.5 A.	- dGV				1000
Drain Gate + Source Gate On-Capacitance (VDS = 0 Vdc, VGS = 0, f = 1.0 MHz)	parinto ou - p	C _{dg(on)}	-		85	pF
		C _{sg(on)}	ROTHETTOS	AMARIO BO	OTO MINUS	1.8008
Drain Gate Off-Capacitance $(V_{DS} = 0 \text{ Vdc}, V_{GS} = -10 \text{ V}, f = 1.0 \text{ MHz})$	(RFF430	C _{dg(off)}	-	_	ети 15	pF
Source Gate Off-Capacitance (Vps = 0 Vdc, Vgs = -10 V, f = 1.0 MHz)	(no)gl batefi	C _{sg(off)}	_	- 81	15	pF

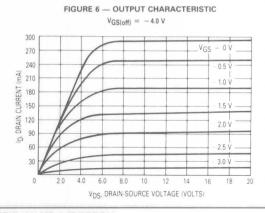
(1) Pulse Duration 300 μ s, Duty Cycle \leq 2.0%.



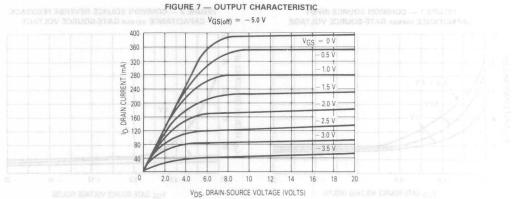


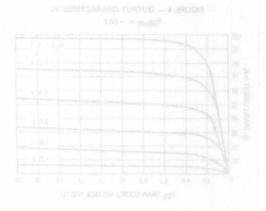


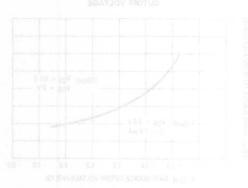


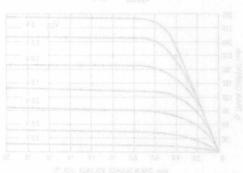


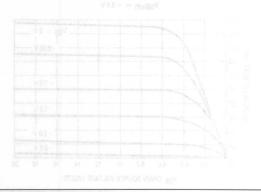












CASE 29-04, STYLE 30

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	inti -35	Vdc
Gate-Source Voltage	VGS	ab∀ −35	Vdc
Gate Current	IG	50 50	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.68	mW mW/°C
Lead Temperature	TL	300	°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	S °C

J111 J112 J113

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET CHOPPER TRANSISTOR

N-CHANNEL — DEPLETION

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	fodmy8		niteliotomani.	3		
Gate-Source Breakdown Voltage			V(BR)GSS	35	ante la tros	Vdc
$(I_G = -1.0 \ \mu A)$	Verguerone			Voltage	awahdawii x	Barre Saint
Gate Reverse Current (VGS = -15 V)	900		IGSS	_	-1.0	nA
Gate Source Cutoff Voltage	900		VGS(off)		20 Volts)	V
$(V_{DS} = 5.0 \text{ V}, I_{D} = 1.0 \mu\text{A})$		J111 J112 J113		-3.0 -1.0 -0.5	-10 -5.0 -3.0	Gat-sour
Drain-Cutoff Current (VDS = 5.0 V, VGS = -10 V)		951L 551L	I _{D(off)}	_	1.0	nA
ON CHARACTERISTICS					CTERISTICS	ON CHAR
Zero-Gate-Voltage Drain Current* (VDS = 15 V)	*aadi	J111 J112 J113	IDSS	20 5.0 2.0	voltege Drein - 18 dr -	s mAs
Static Drain-Source On Resistance (V _{DS} = 0.1 V)	(not201	J111 J112 J113	rDS(on)	son ut riasi	30.02- 11.50 1.0- 100	Ohms ka G sta
Drain Gate and Source Gate On-Cap (VDS = VGS = 0, f = 1.0 MHz)	pacitance		C _{dg(on)}	_	28	pF
			C _{sg(on)}	lyty Gygle 4	ац 000 = r	this in Jugar
Drain Gate Off-Capacitance $(V_{GS} = -10 \text{ V}, f = 1.0 \text{ MHz})$			C _{dg(off)}	_	5.0	pF
Source Gate Off-Capacitance (VGS = -10 V, f = 1.0 MHz)			C _{sg(off)}	_	5.0	pF

^{*}Pulse Width = 300 μ s, Duty Cycle = 3.0%.

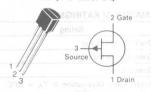
MAXIMUM RATINGS

6

III DAINIGIN I DAINIGO			
Rating	Symbol	Value 3	Unit
Drain-Source Voltage	V _{DS}	30	Vdc
Drain-Gate Voltage	V _{DG}	Am 30	Vdc
Gate-Source Voltage	VGS	30	Vdc
Gate Current	IG	50	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

J174 J175 J176 J177

CASE 29-04, STYLE 30 TO-92 (TO-226AA)



JFET. CHOPPER TRANSISTOR

P-CHANNEL — DEPLETION Refer to MPF970 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	V(BH)GSS			SparioV	: Breakdown	หนด ๑๔๕ปี
Gate-Source Breakdown Voltage (I _G = 1.0 μA)	less		V(BR)GSS	30	Inequal or	Vdc
Gate Reverse Current (VGS = 20 Volts)	VGS(off)		IGSS	abi	1.0 cl	nA
Gate Source Cutoff Voltage (V _{DS} = -15 V, I _D = -10 nA)		J174 J175	VGS(off)	5.0 3.0	10	Vdc
		J176 J177		1.0	4.0	orome () in a liter

ON CHAR	ACTERISTICS						ADTERISTICS.	SAKO WO
Zero-Gate	Voltage Drain	Current	sadi		IDSS*	*Inemo) :	istQ opelor	mA
$(V_{DS} =$	-15 V)			J174		-2.0	- 100	
				J175		-7.0	- 60	
				J176	- 11	-2.0	- 25	
				J177		-1.5	-20	
Static Dra	n-Source On	Resistance			rDS(on)		William	Ω
(VDS ≤	-0.1 Volt)			J174		_	85	
50				J175		_	125	
				J176	anistina	Gate Un-Car	250	
				J177	5571107.070	(e Hate O.)	300	

*Pulse Width = 300 μs, Duty Cycle ≤ 3.0%.

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

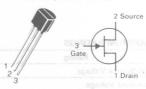
CASE 29-94, STYLE 30 TO-92 (TO-226AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	40	Vdc
Drain-Gate Voltage	V _{DG}	abV 40	Vdc
Gate-Source Voltage	VGS	40	Vdc
Gate Current	IG	50	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Storage Temperature Range	T _{stq}	-65 to +150	00 00 00 00 00 00 00 00 00 00 00 00 00

J202 J203

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET LOW FREQUENCY/LOW NOISE

N-CHANNEL — DEPLETION

Refer to 2N4220 for graphs.

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	nancial M			one Wall	on Brankelenan	
Gate-Source Breakdown Voltage (IG = $-1.0 \mu A$)	SSE(RE)Y		V _(BR) GSS	-40	-tAu (Vdc
Gate Reverse Current (VGS = -20 V)	860		IGSS	-	=100 as	pA
Gate Source Cutoff Voltage (V _{DS} = 20 V, I _D = 10 nA)	Hojso*	J201 J202 J203	VGS(off)	-0.3 -0.8 -2.0	- 1.5 - 4.0 - 10.0	Vdc
ON CHARACTERISTICS	"sedi	3203			- 10.0 HBTU BQSHOV-	0/5:00 5
Zero-Gate-Voltage Drain Current (V _{DS} = 20 V)	istVi	J201 J202 J203	IDSS*	0.2 0.9 4.0	1.0 4.5 20.0	mA
SMALL-SIGNAL CHARACTERISTICS		0724		15P0I/O.	1 = 1.7 ¢1	2017
Forward Transfer Admittance (V _{DS} = 20 V, f = 1.0 kHz)	lvosi	J201 J202 J203	yfs *	500 1000 1500	esidance - 15 V. f =	μ mhos
Pulse Width ≤ 2.0 ms.	Sei			ISHM 0.	1011ance - 15 V, i = 1	stay.

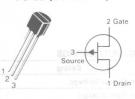
J201 J202 J203 CASE 29-04, STYLE 5 TO-82 (TO-226AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	pbV 30	Vdc
Drain-Gate Voltage	V _{DG}	obV 30	Vdc
Gate-Source Voltage	VGS	30 g	Vdc
Gate Current	IG	50	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	360 3.27	mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +150	0° 65 m

J270 J271

CASE 29-04, STYLE 30 TO-92 (TO-226AA)



JFET CHOPPER TRANSISTOR

P-CHANNEL — DEPLETION

Refer to MPF970 for graphs.

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Solitake		DISERRIGINAL.			A 14 MILES
Gate-Source Breakdown Voltage (I _G = 1.0 μA)	eza(Re)V		V _(BR) GSS	30 epstloV	uwap (sert)	Vdc
Gate Reverse Current (VGS = 20 Volts)	2801		IGSS		200	pA
Gate Source Cutoff Voltage $(V_{DS} = -15 \text{ V}, I_D = -1.0 \text{ nA})$	Vesion	J270 J271	VGS(off)	0.5	2.0 4.5	Vdc
ON CHARACTERISTICS		5051				
Zero-Gate-Voltage Drain Current (VDS = -15 V)	*asel	J270 J271	I _{DSS} *	-2.0 -6.0	- 15 - 50	mA ₀
SMALL-SIGNAL CHARACTERISTIC	S	1920.			100 100	2 J.V.
Forward Transfer Admittance $(V_{DS} = -15 \text{ V}, f = 1.0 \text{ kHz})$		J270 J271	Yfs	6000 8000	15000 18000	μmhos
Output Admittance $(V_{DS} = -15 \text{ V}, f = 1.0 \text{ kHz})$	(a)VI	J270 J271	Yos	(Hz)		μmhos
Input Capacitance (V _{DS} = -15 V, f = 1.0 MHz)			C _{iss}	_	32	pF pF
Reverse Transfer Capacitance (V _{DS} = -15 V, f = 1.0 MHz)			C _{rss}	-	8.0	pF

^{*}Pulse Width ≤ 2.0 ms.

1304 1305

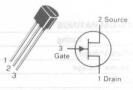
CASE 29-04, STYLE 5

MAXIMUM RATINGS

MAXIMOM NATINGO		93/21 e-11/2	-37
Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	- 25	Vdc
Gate Current	IG	10	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 3.5	mW mW/°C
Lead Temperature (1/16" from Case for 10 Seconds)	TL	300	°C
Junction Temperature Range	TJ	-55 to +150	°C
Storage Temperature Range	T _{stg}	-55 to +150	°C

J300

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET HIGH FREQUENCY AMPLIFIER

N-CHANNEL — DEPLETION

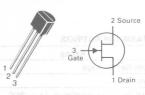
	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	todunks		Silanessenad	talen and		
Gate-Source Breakdown Voltage $(I_G = -1.0 \mu A, V_{DS} = 0)$	Vienicss		V(BR)GSS	- 25 agaileV	ACTEMS NO.	Vdc
Gate Reverse Current (VGS = -15 V, VDS = 0)	less!		IGSS	(0	500	pA
Gate Source Cutoff Voltage (VDS = 10 V, ID = 1.0 mA)	(Hol&D ^V		V _{GS(off)}	- 1.0	-6.0 lev flored as	Vdc
ON CHARACTERISTICS		Jack		LAN I	y'r = Or'A-GL	a Cicya.
Zero-Gate-Voltage Drain Current (VDS = 10 V, VGS = 0)			IDSS	6.0	30	mA
Gate-Source Forward Voltage (VDS = 0, IG = 1.0 mA)	\$50,	J304	V _{GS(f)}	7/12/100 (0)	1.0	Vdc
SMALL-SIGNAL CHARACTERISTIC	S	The second second		Accounts	ACRES FROM	B FIXARE
Forward Transfer Admittance (VDS = 10 V, ID = 5.0 mA, f =	1.0 kHz)		Yfs	4500	9000	μmhos
Output Admittance (V _{DS} = 10 V, I _D = 5.0 mA, f =	1.0 kHz)	pati .	Yos	100 / - 1 O	200	μmhos
Input Capacitance $(V_{DS} = 10 \text{ V}, I_{D} = 5.0 \text{ mA}, f =$	1.0 MHz)	80/01	C _{iss}	_	5.5	pF
Reverse Transfer Capacitance (V _{DS} = 10 V, I _D = 5.0 mA, f =	1.0 MHz)		C _{rss}	-	1.7	pF

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	-30	Vdc
Gate-Source Voltage	VGS	-30	Vdc
Gate Current	IG	10	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD 3	350 3.5	mW mW/°C
Lead Temperature (1/16" from Case for 10 Seconds)	TL	300	°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-55 to +150	07 68 °C

J304 J305

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET HIGH FREQUENCY AMPLIFIER

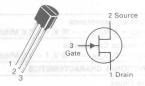
N-CHANNEL — DEPLETION

	Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	Manuaca V			ensulaV s	usesta Sacrati	a inRainE
Gate-Source Breakdown Voltage (IG = 1.0 μ A, VDS = 0)	220		V(BR)GSS	30 🗇 🚽	ggV = n H	Vdc
Gate Reverse Current (VGS = -20 V, VDS = 0)	Majasy		IGSS	— (0 =	100	pA
Gate Source Cutoff Voltage (V _{DS} = 15 V, I _D = 1.0 nA)		J304 J305	VGS(off)	-2.0 -0.5	-6.0 -3.0	Vdc
ON CHARACTERISTICS	580			- Status n	ranti spolini - weste ti n	A TREE OFFICE
Zero-Gate-Voltage Drain Current $(V_{DS} = 15 \text{ V}, V_{GS} = 0)$	(hea/V	J304 J305	IDSS	5.0 1.0	15 8.0	mA
SMALL-SIGNAL CHARACTERISTICS				Dirementor	Marine Carlos	S-25Atms
Output Admittance (V _{DS} = 15 V, V _{GS} = 0, f = 1.0 kH	Hz)		Yos	0 mA, T = 1	50	μmhos
Forward Transconductance ($V_{DS} = 15 \text{ V}, V_{GS} = 0, f = 1.0 \text{ kHz}$	Your (zh	J304 J305	Re(yfs)	4500 3000	7500	μmhos

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refer or = 1 J310 V CI = 20

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



SHW (IS) = 1.AmJFET VHF/UHF AMPLIFIER

N-CHANNEL - DEPLETION

Refer to U308 for graphs.

Symbol

MAXIMUM RATINGS

ag Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Gate-Source Voltage	VGS	25	Vdc
Forward Gate Current	IGF	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 3.5	mW mW/°C
Junction Temperature Range	TJ	-55 to +125	°C
Storage Temperature Range	T _{stg}	-55 to +150	°C

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Gate-Source Breakdown Voltage (I _G = -1.0 µA, V _{DS} = 0)		V _(BR) GSS	- 25	_	_	Vdc
Gate Reverse Current $(V_{GS} = -15 \text{ V}, V_{DS} = 0, T_A = 25^{\circ}\text{C})$ $(V_{GS} = -15 \text{ V}, V_{DS} = 0, T_A = +125^{\circ}\text{C})$		IGSS	_	_	- 1.0 - 1.0	nΑ μΑ
Gate Source Cutoff Voltage $(V_{DS} = 10 \text{ V}, I_D = 1.0 \text{ nA})$	J308 J309 J310	VGS(off)	- 1.0 - 1.0 - 2.0		- 6.5 - 4.0 - 6.5	Vdc
ON CHARACTERISTICS						
Zero-Gate-Voltage Drain Current(1) $(V_{DS} = 10 \text{ V}, V_{GS} = 0)$	J308 J309 J310	IDSS	12 12 24	_	60 30 60	mA
Gate-Source Forward Voltage (V _{DS} = 0, I _G = 1.0 mA)		V _{GS(f)}	_	_	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Common-Source Input Conductance ($V_{DS} = 10 \text{ V}$, $I_D = 10 \text{ mA}$, $f = 100 \text{ MHz}$)	J308 J309 J310	Re(y _{is})	=	0.7 0.7 0.5	=	mmhos
Common-Source Output Conductance (V _{DS} = 10 V, I _D = 10 mA, f = 100 MHz)		Re(yos)	-	0.25	_	mmhos
Common-Gate Power Gain (V _{DS} = 10 V, I _D = 10 mA, f = 100 MHz)		G _{pg}	_	16	_	dB
Common-Source Forward Transconductance (V _{DS} = 10 V, I _D = 10 mA, f = 100 MHz)		Re(yfs)	_	12	1 -	mmhos
Common-Gate Input Conductance $(V_{DS} = 10 \text{ V}, I_D = 10 \text{ mA}, f = 100 \text{ MHz})$		Re(yig)	_	12	_	mmhos
Common-Gate Forward Transconductance ($V_{DS} = 10 \text{ V}$, $I_D = 10 \text{ mA}$, $f = 1.0 \text{ kHz}$)	J308 J309 J310	9fs	8000 10000 8000	_	20000 20000 18000	μmhos
Common-Gate Output Conductance ($V_{DS} = 10 \text{ V}$, $I_D = 10 \text{ mA}$, $f = 1.0 \text{ kHz}$)	J308 J309 J310	9os		_	200 150 200	μmhos

ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
Common-Gate Forward Transconductance ($V_{DS} = 10 \text{ V}, I_D = 10 \text{ mA}, f = 1.0 \text{ kHz}$)	J30 J30	09	9fg	=	13000 13000 12000	_	μmhos
Common-Gate Output Conductance ($V_{DS} = 10 \text{ V}$, $I_D = 10 \text{ mA}$, $f = 1.0 \text{ kHz}$)	13. 130 130	09	9og	_	150 100 150	_	μmhos
Gate-Drain Capacitance (V _{DS} = 0, V _{GS} = -10 V, f = 1.0 MHz)			C _{gd}	_	1.8	2.5	pF MXAM
Gate-Source Capacitance (V _{DS} = 0, V _{GS} = -10 V, f = 1.0 MHz)	JinU mV	Value	Cgs	_	4.3	5.0	pF Drain-Sc
FUNCTIONAL CHARACTERISTICS							Half-staff
Noise Figure (V _{DS} = 10 V, I _D = 10 mA, f = 450 MHz)	ohAm	at	NF	-	1.5	ero-Tok	dB
Equivalent Short-Circuit Input Noise Voltage (VDS = 10 V, ID = 10 mA, f = 100 Hz)	3°Wm	6.6	ēn		10	793 - 116	nV/√Hz
1) Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant	3.0%,	081 + 01 00	pta [†]		Range	and and	Storage

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MFE120 MFE121 MFE122

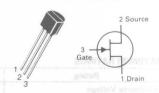
CASE 20-03, STYLE 9

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	20	Vdc
Gate-Source Voltage	VGS	mat) 25 ga	Vdc
Drain Current	ID	ъБУ 20 а	mA
Forward Gate Current	IGF	10	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +150	an æ3°C

JF1033B JF1033S JF1033Y

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



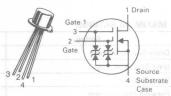
JFET HIGH FREQUENCY AMPLIFIER

N-CHANNEL DEPLETION

		teristic	(1991011 0319/1971/10 253)	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	378941	Touristo		V(20) 200 200	10110		
Gate-Source Breakdown Voltage ($I_G = -10 \mu A$)	.25	хениву		V _(BR) GSS	-25 egolloV	wabisata Brasidowi	Vdc
Drain-Source Breakdown Voltage ($I_D = 10 \mu A$)	0.7 =	VIBRIGISO	18 08 7	V(BR)DGO	20	ce Breakdon	Vdc
Gate Reverse Current (VGS = -10 V, VDS = 0)	±7.0	V(BR)G2SO		IGSS	n Voltage	- 100 vobalana	
Gate Source Cutoff Voltage $(V_{DS} = 10 \text{ V}, I_{D} = 10 \mu\text{A})$		eara!		VGS(off)	-1.0	-8.0	Vdc
ON CHARACTERISTICS				10 - 13	A TO A SPE	Fe (00 A D O A	SLEIN
Zero-Gate-Voltage Drain Current (V _{DS} = 10 V, V _{GS} = 0)		(HOSIDA SEXT.	JF1033Y JF1033B JF1033S	IDSS 8	2.5 5.0 10.0	6.0 12.0 20.0	mA
SMALL-SIGNAL CHARACTERISTI	CS	-Vazsterii			vestiov	Note Cutoff	
Forward Transconductance (V _{DS} = 10 V, V _{GS} = 0, f = 1.0	kHz)			Re(yfs)	4.5	13.0	mmhos
FUNCTIONAL CHARACTERISTICS	3	820			Current	oluge Drain	V-atstacie
Noise Figure (V _{DS} = 10 V, V _{GS} = 0, f = 10	0 MHz)		12199M MRE122 MRE122	NF	SEEL TO -	2.5	dB

MFE120 MFE121 MFE122

CASE 20-03, STYLE 9 TO-72 (TO-206AF)



DUAL-GATE MOSFET VHF AMPLIFIER

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	+ 25	Vdc
Drain Current	ID	Am 30	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.7	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +175	o oc

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS			600	TOPPOLITARE	AND THE
Drain-Source Breakdown Voltage (ID = 100 μ Adc, VS = 0, VG1S = -4.0 V, VG2S = +4.0 V)	V(BR)DSX	25	agangy 117.	- FOL 01	Vdc
Gate 1-Source Breakdown Voltage (I _{G1} = ±10 μAdc, V _{G2S} = 0)	V(BR)G1SO	± 7.0	SESSION HVV	± 20	Vdc
Gate 2-Source Breakdown Voltage (I _{G2} = ±10 μAdc, V _{G2S} = 0)	V _(BR) G2SO	± 7.0	(<u>0</u> = 5)	± 20	Vdc
Gate 1 Leakage Current (V _{G1S} = +6.0 Vdc, V _{G2S} = 0, V _{DS} = 0)	l _{G1SS}	_	10 (JA)	20	nAdc
Gate 2 Leakage Current (VG2S = +6.0 Vdc, VG1S = 0, VDS = 0)	I _{G2SS}	_	tein Current	20	nAdc
Gate 1 to Source Cutoff Voltage ($V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_D = 200 \mu \text{Adc}$)	V _{G1S(off)}	_		-4.0	Vdc
Gate 2 to Source Cutoff Voltage (Vps = 15 Vdc, Vg1s = 0, lp = 200 μ Adc)	V _{G2S} (off)	-601	TERRETTARIST	-4.0	Vdc
ON CHARACTERISTICS		falls (1.f = 1.0 =	sets 7 of	Newson Williams
Zero-Gate-Voltage Drain Current	IDSS	2.0	ACTEMBET	TAHO JAM	mAdd

	IDSS	35	OTTOWNSTEEL	TRAINS LAW	mAdc
MFE120		2.0	7.0	18	
MFE121		5.0	10	30	Noise No
MFE122		2.0	9.0	20	- say
	MFE121	MFE120 MFE121	MFE120 2.0 MFE121 5.0	MFE120 2.0 7.0 MFE121 5.0 10	MFE120 2.0 7.0 18 MFE121 5.0 10 30

SMALL-SIGNAL CHARACTERISTICS

Forward Transfer Admittance (Gate 1 to Drain) ($V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc},$ $I_{D} = 10 \text{ mAdc}, f = 1.0 \text{ kHz})$	MFE120,22 MFE121	Yfs	8000 10,000	_	18,000 20,000	μmhos
Input Capacitance $ \begin{array}{ll} (V_{DS}=15~\text{Vdc}, V_{G2S}=4.0~\text{Vdc}, \\ I_{D}=I_{DSS}, f=1.0~\text{MHz}) \end{array} $	MFE120,22 MFE121	C _{iss}	=	4.5 4.5	7.0 6.0	pF
Reverse Transfer Capacitance $(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_D = 6.0 \text{ mAdc}, f = 1.0 \text{ MHz})$		C _{rss}	_	0.023	_	pF
Output Capacitance (V _{DS} = 15 Vdc, V _{G2S} = 4.0 Vdc, I _D = I _{DSS} , f = 1.0 MHz)	MFE120,22 MFE121	C _{oss}	_	2.5 2.5	4.0 3.5	pF

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ELECTRICAL CHARACTERISTICS (continued) (TA = 25°C unless otherwise noted.)

		Symbol	Min	Тур	Max	Unit
65						
MFE120 MFE121 MFE121	700 4 0	NF (sirid	2.9 2.6 2.6	5.0 5.0 5.0	dB
MFE120 MFE121 MFE121	101	G _{ps}	17 20 17	19.6 27.8 18.6		dB
19 0E-03		1 1	FOO:	100	_	mV
unit Tel bagget tals			24			dB
MFE122			15	16.5	_	
	MFE121 MFE121 MFE120 MFE121 MFE121 n, Figure 2)	MFE121 MFE121 MFE120 MFE121 MFE121 n, Figure 2)	MFE120 MFE121 MFE121 MFE120 MFE121 MFE121 MFE121 — n, Figure 2) G _C	MFE120 — — — — — — — — — — — — — — — — — — —	MFE120 — 2.9 MFE121 — 2.6 MFE121 — 2.6 MFE121 — 2.6 MFE120 — 17 19.6 MFE121 — 20 27.8 MFE121 — 100 n, Figure 2) G _C	MFE120 — 2.9 5.0 MFE121 — 2.6 5.0 MFE121 — 2.6 5.0 Gps MFE120 17 19.6 — MFE121 20 27.8 — MFE121 17 18.6 — 17 19.6 — 100 — n, Figure 2) G _C

FIGURE 1 — 60, 105 AND 200 MHz POWER GAIN AND NOISE FIGURE TEST CIRCUIT

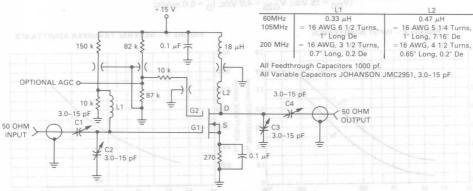
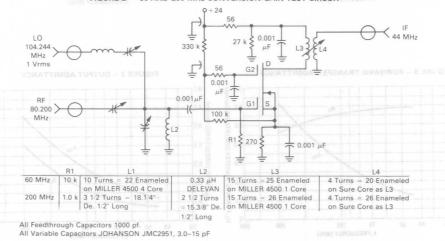
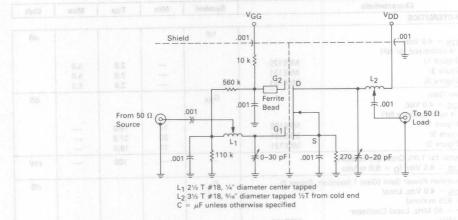


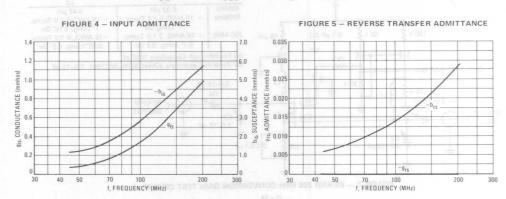
FIGURE 2 — 60 AND 200 MHz CONVERSION GAIN TEST CIRCUIT

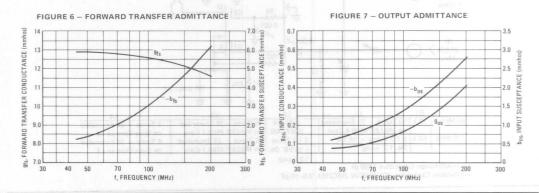


MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

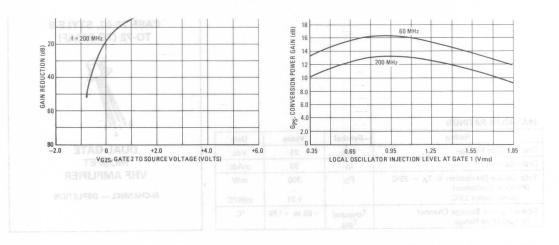


COMMON-SOURCE ADMITTANCE PARAMETERS (VDS = 13 MUST) (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = 6.0 mAdc)





MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



			Crail Service Breakdown Voltage (Ip. = 10 uAd6, Vs. = 9, Vgy. = -4,
			Sate 2 to Source Cutoff Voltage (Vtg = 15 Vdc, Vgrg = 0, lg = 200
,			
		Hari	

MFE130,131,132

CASE 20-03, STYLE 9 TO-72 (TO-206AF)



DUAL-GATE MOSFET VHF AMPLIFIER

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	25	Vdc
Drain Current	ID	30	mAdc
Total Device Dissipation @ T _A = 25°C (Package Limitation) Derate above 25°C	PD	300 1.71	mW mW/°C
Operating and Storage Channel Temperature Range	T _{channel}	-65 to +175	°C

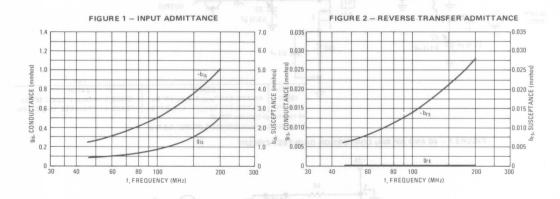
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (ID = 10 μ Adc, V _S = 0, V _{G1} = -4.0 V, V _{G2} = +4.0 V)	V _{(BR)DSX}	25	_	_	Vdc
Gate 1-Source Breakdown Voltage $(I_{G1} = \pm 10 \ \mu Adc, V_{G2S} = 0)$	V(BR)G1SO	± 7.0	_	± 20	Vdc
Gate 2-Source Breakdown Voltage $(I_{G2} = \pm 10 \ \mu Adc, V_{G2S} = 0)$	V(BR)G2SO	±7.0	_	± 20	Vdc
Gate 1 Leakage Current $(V_{G1S} = \pm 6.0 \text{ Vdc}, V_{G2S} = 0, V_{DS} = 0)$	IG1SS	_	_	20	nAdc
Gate 2 Leakage Current $(V_{G2S} = \pm 6.0 \text{ Vdc}, V_{G1S} = 0, V_{DS} = 0)$	I _{G2SS}		_	20	nAdc
Gate 1 to Source Cutoff Voltage $(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_{D} = 200 \mu\text{Adc})$	VG1S(off)	-	_	-4.0	Vdc
Gate 2 to Source Cutoff Voltage (V _{DS} = 15 Vdc, V _{G1S} = 0, I _D = 200 μAdc)	VG2S(off)	-	_	-4.0	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current (V _{DS} = 15 Vdc, V _{G1S} = 0, V _{G2S} = 4.0 Vdc)	IDSS	3.0	10	30	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance (Gate 1 connected to Drain) (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = 10 mAdc, f = 1.0 kHz)	lyfs	8000	_	20000	μmhos
Input Capacitance $(V_{DS} = 15 \text{ Vdc } V_{G2S} = 4.0 \text{ Vdc}, I_D = I_{DSS}, f = 1.0 \text{ MHz})$	C _{iss}	_	4.5	7.0	pF
Reverse Transfer Capacitance $(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_{D} = 6.0 \text{ mAdc}, f = 1.0 \text{ MHz})$	C _{rss}	_	0.023	0.05	pF
Output Capacitance $(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_{D} = I_{DSS}, f = 1.0 \text{ MHz})$	Coss	_	2.5	4.0	pF
FUNCTIONAL CHARACTERISTICS					
	NF FE130 FE131		2.9 2.5	5.0 5.0	dB

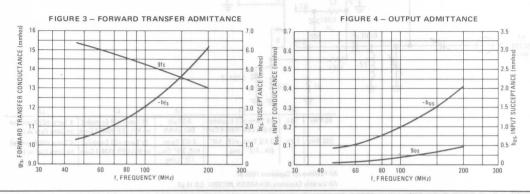
ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
Common Source Power Gain (Figure 7)	- B	Gps	100			dB
$(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc},$	1 2					100 E
ID = 6.0 mAdc, Z _S is optimized for NF)	1455400		4.7	00		. 7
(f = 105 MHz)	MFE130		17	23	Wit Uliv	10 B
(f = 60 MHz)	MFE131		20	27	-	1 1
(f = 200 MHz)	MFE131		17	20	0.05 2.3	
Level of Unwanted Signal for 1.0% Cross Modulation (V _{DS} = 15 Vdc, V _{G2S} = 4.0 Vdc, I _D = 6.0 mAdc)	SAPRE 19			100	1	mV
Common-Source Conversion Power Gain (Gate 1 Injecti (V _{DS} = 15 Vdc, V _{G2S} = 4.0 Vdc, Local Oscillator Voltage = 925 mVrms)	ion, Figure 8)	G _C				dB
(Signal Frequency = 60 MHz, Local Oscillator	81			44		2.6%
Frequency = 104 MHz) (Signal Frequency = 200 MHz, Local Oscillator	MFE132		15	16.5	v -	
Frequency = 244 MHz) 7145A15 1231 3 8451 3 8	MFE132		30/120	14	_	

COMMON-SOURCE ADMITTANCE PARAMETERS

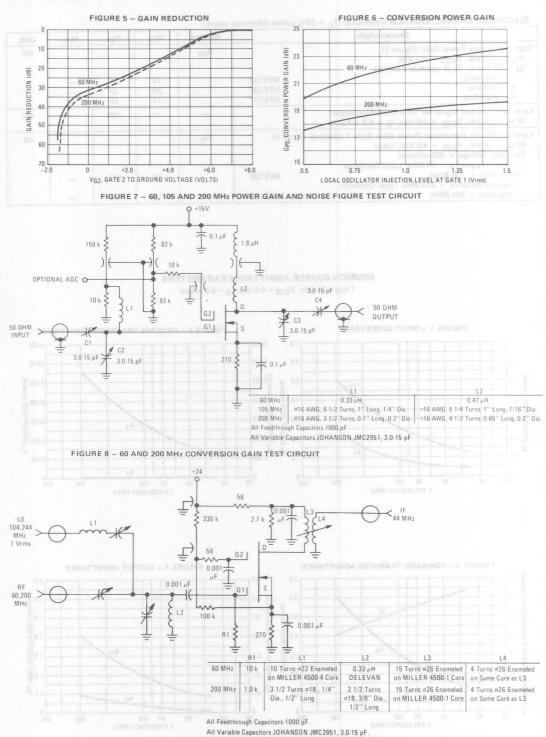
(VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = 6.0 mAdc)





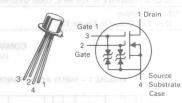
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





MFE140

CASE 20-03, STYLE 9 TO-72 (TO-206AF)



DUAL-GATE MOSFET FM AMPLIFIER

N-CHANNEL — DEPLETION

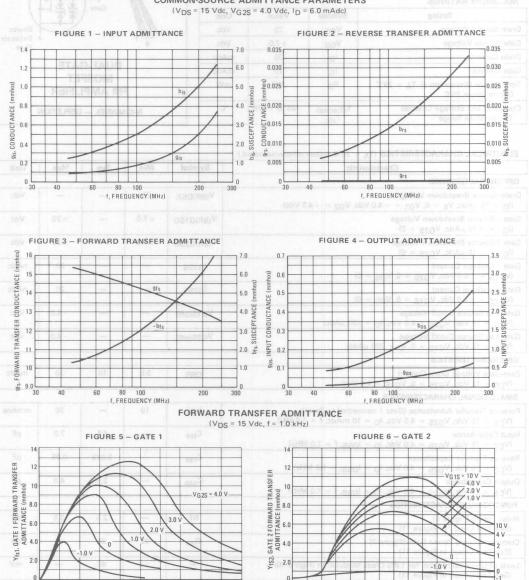
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	25	Vdc
Gate-Source Voltage	VGS	±7.0	Vdc
Drain Current	ID	30	mAdo
Gate Current	IG	10	mAdo
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300	mW
Operating and Storage Channel Temperature Range	T _{channel} ,	-65 to +175	°C

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	0				- U
Drain-Source Breakdown Voltage (Lipsell Lipsell V _{(BR)DSX}	25	gs2,=	_	Vdc	
Gate 1-Source Breakdown Voltage ($I_{G1} = \pm 10 \ \mu Adc, V_{G2S} = 0$)	V(BR)G1SO	±7.0	_	± 20	Vdc
Gate 2-Source Breakdown Voltage (IG2 = $\pm 10 \mu$ Adc, VG2S = 0)	V(BR)G2SO	±7.0	r dawyad	± 20	Vdc
Gate 1 Leakage Current $(V_{G1S} = \pm 6.0 \text{ Vdc}, V_{G2S} = 0, V_{DS} = 0)$	I _{G1SS}			20	nAdc
Gate 2 Leakage Current $(V_{G2S} = \pm 6.0 \text{ Vdc}, V_{G1S} = 0, V_{DS} = 0)$	IG2SS	#T		20	nAdc
Gate 1 to Source Cutoff Voltage (V _{DS} = 15 Vdc, V _{G2S} = 4.0 Vdc, I _D = 200 μAdc)	VG1S(off)	>		-4.0	Vdc
Gate 2 to Source Cutoff Voltage (V _{DS} = 15 Vdc, V _{G1S} = 0, I _D = 200 μAdc)	VG2S(off)			-4.0	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current (VDS = 15 Vdc, VG2S = 0, VG2S = 4.0 Vdc)	IDSS	3.0	10	30	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Forward Transfer Admittance (Gate 1 connected to Drain) (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = 10 mAdc, f = 1.0 kHz)	AT CHA Yfs	10	_	20	mmhos
Input Capacitance STAD - 8 SHUDD (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = IDSS, f = 1.0 MHz)	C _{iss}	rataa -	3,4.5	7.0	pF
Reverse Transfer Capacitance $(V_{DS} = 15 \text{ Vdc}, V_{G2S} = 4.0 \text{ Vdc}, I_D = I_{DSS}, = 1.0 \text{ MHz})$	C _{rss}		0.023	0.05	pF
Output Capacitance (VDS = 15 Vdc, VG2S = 4.0 Vdc, ID = IDSS, f = 1.0 MHz)	Coss	XX	2.5	4.0	pF
FUNCTIONAL CHARACTERISTICS		11		1	18 2 2
Noise Figure (Figure 8) (See Test Circuit in Figure 11)	NF/103	hat/	2.5	3.5	dB
Common Source Power Gain (Figure 7) (See Test Circuit in Figure 11)	Gps	20	23	71	dB
Level of Unwanted Signal for 1.0% Cross Modulation (Figure 10) (See Test Circuit in Figure 11)		THE	45		mV

Common-Source Conversion Power Gain (Gate 1 or Gate 2 Injection, Figure 12) (See Test Circuit in Figure 13) (Signal Frequency = 100 MHz, Local Oscillator Frequency = 110.7 MHz)	G _c	15	18.5	_	dB
1/2 I.F. Rejection (See Test Circuit in Figure 13)	1/2 I _{FREJ}	-	50	_	dB

COMMON-SOURCE ADMITTANCE PARAMETERS

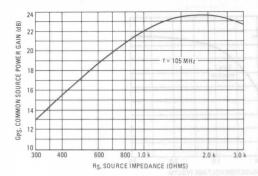


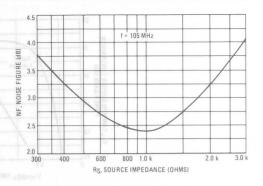
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

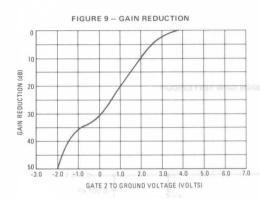
0 0 1.0 2.0 VG1S, GATE 1 SOURCE VOLTAGE (VOLTS)

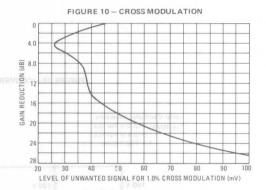
VG2S, GATE 2 SOURCE VOLTAGE (VOLTS)

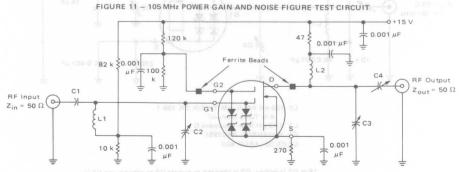










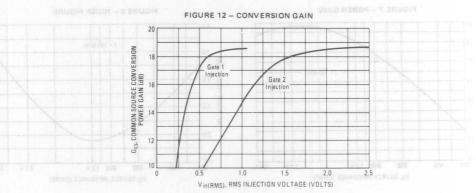


The following component values are for a <u>stern</u> stability factor = 2.0. L1,L2 126 nH PAUL SMITH CO. SK-138-1 4-½ Turns (yellow)

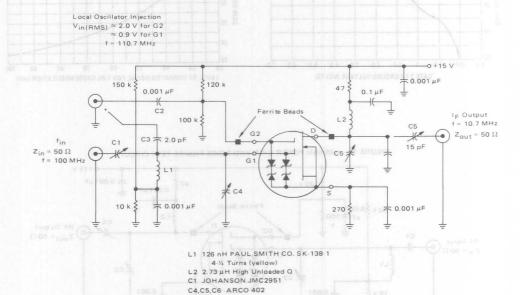
C1 Nominal 7.0 pF Adjusted for source impedance of approximately 1000 Ω , JOHANSON JMC2951

C2 Nominal 4.0 pF ARCO 402
C3 Nominal 13.73 pF ARCO 403
C4 Nominal 4.36 pF JOHANSON JMC2951
All Decoupling Capacitors are Ceramic Discs.







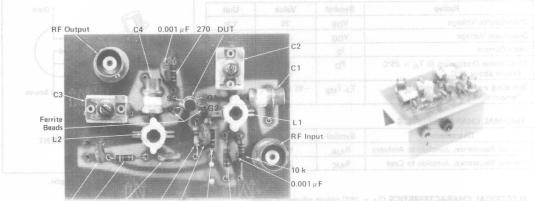


*For G1 injection, C2 is changed to bypass G2 to ground and C3 is added to connect G1 to the injection input.

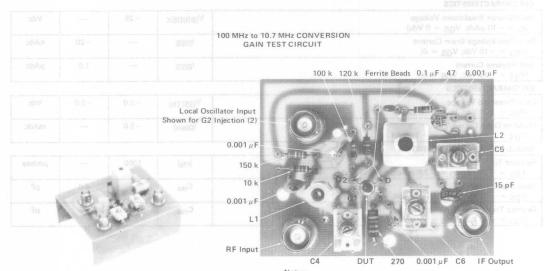
PRINTED CIRCUIT BOARD LAYOUT INFORMATION

FIGURE 14 – TEST FIXTURES

105 MHz POWER GAIN AND NOISE FIGURE TEST CIRCUIT



0.001 μF 47 0.001 μF 100 k 0.001 μF 120 k 82 k



Notes:
1. C1 is on the bottom side of the board.
2. For G1 Injection, C2 is changed to bypass
G2 to ground and C3 is added to connect G1 to
the injection input. See Figure 13.

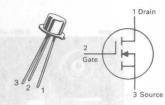
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG}	±10	Vdc
Drain Current	ID	30	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 1.71	mW mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +175	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	584	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	250	°C/W

MFE823

CASE 22-03, STYLE 11 TO-18 (TO-206AA)



MOSFET

P-CHANNEL — ENHANCEMENT

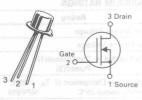
Refer to 2N4352 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Drain-Source Breakdown Voltage (ID = -10 µAdc, VGS = 0 Vdc)	V(BR)DSX	- 25	_	Vdc
Zero-Gate-Voltage Drain Current (V _{DS} = -10 Vdc, V _{GS} = 0)	IDSS	-	-20	nAdc
Gate Reverse Current (VGS = -10 Vdc, VDS = 0)	IGSS	-	1.0	pAdc
ON CHARACTERISTICS				
Gate Threshold Voltage ($V_{DS} = -10 \text{ Vdc}$, $I_{D} = -10 \mu \text{Adc}$)	VGS(Th)	-2.0	-6.0	Vdc
On-State Drain Current (V _{DS} = -10 Vdc, V _{GS} = -10 Vdc)	ID(on)	-3.0	_	mAdc
SMALL-SIGNAL CHARACTERISTICS				
Forward Transfer Admittance $(V_{DS} = -10 \text{ Vdc}, I_D = -2.0 \text{ mAdc}, f = 1.0 \text{ kHz})$	Yfs	1000	_	μmhos
Input Capacitance $(V_{DS} = -10 \text{ Vdc}, V_{GS} = -10 \text{ Vdc}, f = 1.0 \text{ MHz})$	C _{iss}	76 7	6.0	pF
Reverse Transfer Capacitance $(V_{DS} = -10 \text{ Vdc}, V_{GS} = -10 \text{ Vdc}, f = 1.0 \text{ MHz})$	C _{rss}		1.5	pF

PRIMIED CIRCUIT BOARD LAYOUT INFORMATION

CASE 22-03, STYLE 2 TO-18 (TO-206AA)



MOSFET

N-CHANNEL — DEPLETION

Refer to 2N3796 for graphs.

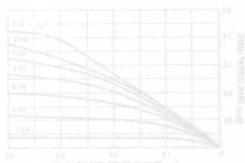
CASE 29-03, STYLE 22 MAXIMUM RATINGS

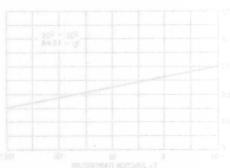
Rating SS-OT	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	20	Vdc
Gate-Source Voltage	VGS	30	Vdc
Drain Current	ID	25	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	200	mW mW/°C
Junction Temperature Range	TJ	150	°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +150	00 m°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Charac	teristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					POLIFICIALISM	HAHO HHO
Drain-Source Breakdown Voltage ($I_D = 1.0 \mu A$, $V_{GS} = -8.0 V$)	-	lpss lpss	V(BR)DSX	20	riei0 Spatiol	Vdc
Gate Reverse Current (VGS = -10 V, VDS = 0 V)		loss	lgss	- (1,00 se	pA
Gate Source Voltage (I _D = 1.0 μA, V _{DS} = 2.0 V)	0/3	SEG(88)V	V _G s		2.0	Vdc
ON CHARACTERISTICS					CLEMBAICS	trako vi
Zero-Gate-Voltage Drain Current (VDS = 10 V, VGS = 0)	0.3	(H)RaV	IDSS	1.0	25 60	
SMALL-SIGNAL CHARACTERISTI	cs	Vogteral			oe On-Veitage	nuo2-n.s. (
Forward Transfer Admittance (VDS = 10 V, VGS = 0, f = 1.0	kHz)	teated	Yfs	500	0 V, l p = 50 ein Current	μmhos
				(V 0	15 V. Vos =	







MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

MFE825

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	60	Vdc
Gate-Source Voltage	VGS	± 15	Vdc
Drain Current — Continuous(1) Pulsed(2)	I _D	0.5 1.0	Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C MPF910	PD	1.0 8.0	Watts mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C MFE910	PD	6.25	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

(1) The Power Dissipation of the package may result in a lower continuous drain current.

(2) Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

6

MFE910 MPF910

MFE910 CASE 79-02, STYLE 6 TO-39 (TO-205AD)



MPF910 CASE 29-03, STYLE 22 (TO-226AE) TO-92



2 Source

TMOS SWITCHING

N-CHANNEL — ENHANCEMENT

Refer to 2N6659 for additional graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

sinU xaM Cha	racteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				831	TELENTOA	DIFF CHAR
Zero-Gate-Voltage Drain Current (VDS = 40 V, VGS = 0)	xeg(sa)V	IDSS	-	0.1	10	μAdc
Gate Reverse Current (VGS = 10 V, VDS = 0)	less)	IGSS	-	0.01	10	nAdc
Drain-Source Breakdown Voltage (VGS = 0, ID = 100 μA)	Yes	V(BR)DSS	60	90	agadicy a	Vdc
ON CHARACTERISTICS				80	IT BEHSTON	MANO NO
Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 1.0 mA)	esci	VGS(th)	0.3	1.5	2.5	Vdc
Drain-Source On-Voltage (VGS = 10 V, I _D = 500 mA)	latvi	V _{DS(on)}	_ 801	nationes	2.5	Vdc
On-State Drain Current (VDS = 25 V, VGS = 10 V)		ID(on)	500	1.0 = 1.0	\$0V_V01	mA
Forward Transconductance (V _{DS} = 15 V, I _D = 500 mA)		9fs	100	-	-	mmhos

FIGURE 1 — VGS(th) NORMALIZED versus TEMPERATURE

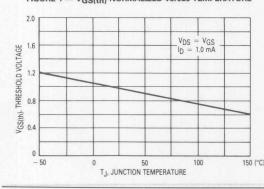
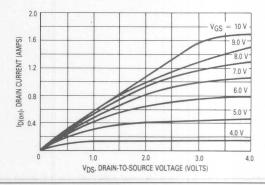
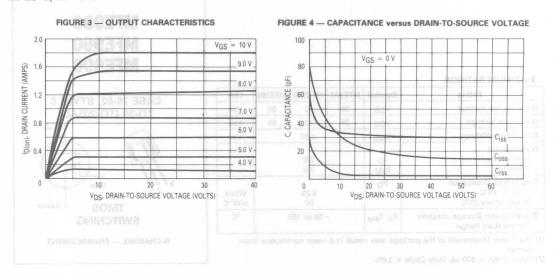


FIGURE 2 — ON-REGION CHARACTERISTICS



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS



ate Boverse Current Lag = 15 Vec, Vpg = 0)				
Tate Threshold Voltage IVps = Vqs, Ip = 1.6 ntA)				
	MPESSO MPESSO MPESSO			
Inverse Transfer Capacitance [VDS = 25 V, VGS = 0, f = 1,0 MHz)				

MAYIMI IM DATINGS

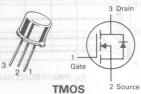
Rating	Symbol	MFE930	MFE960	MFE990	Unit
Drain-Source Voltage	VDS	35	60	90	Vdc
Drain-Gate Voltage	VDG	35	60	90	Vdc
Gate-Source Voltage	VGS		± 30	U	Vdc
Drain Current Continuous(1) Pulsed(2)	I _D	2.0 3.0			Adc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD 05	M 6		9	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to 150		0	°C

(1) The Power Dissipation of the package may result in a lower continuous drain current.

(2) Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MFE930 MFE960 MFE990

CASE 79-02, STYLE 6 TO-39 (TO-205AD)



SWITCHING

N-CHANNEL — ENHANCEMENT

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage: $(V_{GS} = 0, I_{D} = 10 \mu A)$	MFE930 MFE960 MFE990	V(BR)DSX	35 60 90	=	=	Vdc
Gate Reverse Current (V _{GS} = 15 Vdc, V _{DS} = 0)		IGSS	-	_	50	nAdc
ON CHARACTERISTICS*						
Zero-Gate-Voltage Drain Current (V _{DS} = Maximum Rating, V _{GS} = 0)		IDSS	-	_	10	μAdc
Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 1.0 mA)		VGS(Th)	1.0	-	3.5	Vdc
Drain-Source On-Voltage ($V_{GS} = 10 \text{ V}$) ($I_D = 0.5 \text{ A}$)	MFE930 MFE960 MFE990	VDS(on)	Ξ	0.4 0.6 0.6	0.7 0.8 1.2	Vdc
(I _D = 1.0 A)	MFE930 MFE960 MFE990		Ξ	0.9 1.2 1.2	1.4 1.7 2.4	
$(I_D = 2.0 \text{ A})$	MFE930 MFE960 MFE990		Ξ	2.2 2.8 2.8	3.0 3.5 4.8	
Static Drain-Source On Resistance (VGS = 10 Vdc, I _D = 1.0 Adc)	MFE930 MFE960 MFE990	rDS(on)	Ξ	0.9 1.2 1.2	1.4 1.7 2.0	Ohms
On-State Drain Current (V _{DS} = 25 V, V _{GS} = 10 V)		I _{D(on)}	1.0	2.0	_	Amps
SMALL-SIGNAL CHARACTERISTICS						
Input Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)		C _{iss}	_	60	70	pF
Reverse Transfer Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)		C _{rss}	-	13	18	pF
Output Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MHz)		Coss	-	49	60	pF

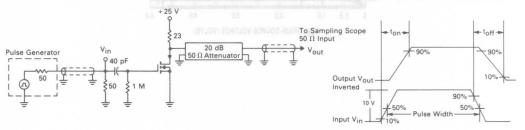
Characteristic	Symbol	Min	Тур	Max	Unit
Forward Transconductance (V _{DS} = 25 V, I _D = 0.5 A)	9fs	200	380	-	mmhos
SWITCHING CHARACTERISTICS*		- 52 星			
Turn-On Time (See Figure 1)	ton	1 - 3	7.0	15	ns
Turn-Off Time (See Figure 1)	toff	3-3	7.0	15	ns

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

RESISTIVE SWITCHING



FIGURE 2 — SWITCHING WAVEFORMS





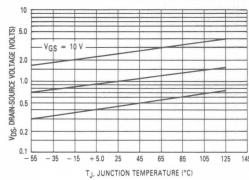


FIGURE 4 — CAPACITANCE VARIATION

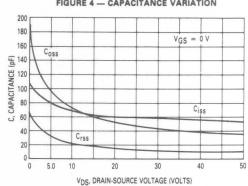


FIGURE 5 — TRANSFER CHARACTERISTIC

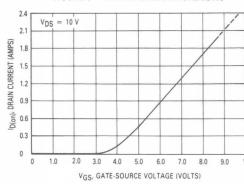
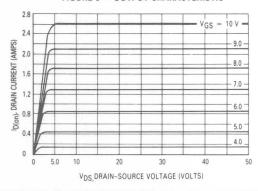
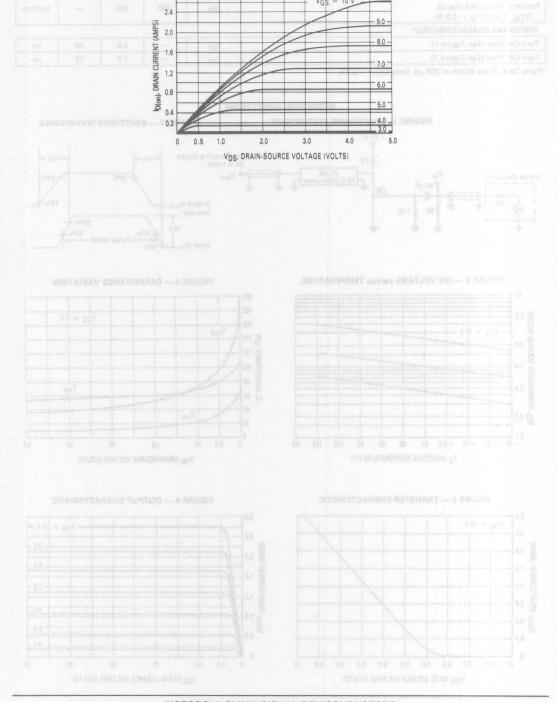


FIGURE 6 - OUTPUT CHARACTERISTIC



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

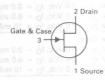




MFE2004 MFE2005 MFE2006

CASE 22-03, STYLE 4 TO-18 (TO-206AA)





JFET CHOPPER

N-CHANNEL — DEPLETION

Refer to 2N4091 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	30	Vdc
Drain-Gate Voltage	V _{DG}	30	Vdc
Gate-Source Voltage	VGS	30	Vdc
Forward Gate Current	IGF	10	mAdc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 10	Watts mW/°C
Junction Temperature Range	TJ	-65 to +175	°C
Storage Temperature Range	T _{stg}	-65 to +200	°C

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage ($I_G = 1.0 \mu Adc, V_{DS} = 0$)		V _(BR) GSS	30	_	Vdc
Gate Reverse Current ($V_{GS} = 20 \text{ Vdc}$, $V_{DS} = 0$) ($V_{GS} = 20 \text{ Vdc}$, $V_{DS} = 0$, $T_A = 150^{\circ}\text{C}$)		IGSS	=	0.2 0.4	nAdc μAdc
Drain Cutoff Current $(V_{DS} = 20 \text{ Vdc}, V_{GS} = 12 \text{ Vdc})$ $(V_{DS} = 20 \text{ Vdc}, V_{GS} = 12 \text{ Vdc}, T_{A} = 150^{\circ}\text{C})$		^I D(off)	=	0.2 0.4	nAdc μAdc
Gate Source Voltage $(V_{DS} = 20 \text{ Vdc}, I_D = 50 \mu \text{Adc})$	MFE2004 MFE2005 MFE2006	VGS	1.0 2.0 5.0	6.0 8.0 10	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current* (VDS = 20 Vdc, VGS = 0)	MFE2004 MFE2005	IDSS*	8.0 15	_	mAdc

Zero-Gate-Voltage Drain Current* (VDS = 20 Vdc, VGS = 0)	MFE2004 MFE2005 MFE2006	IDSS*	8.0 15 30	=	mAdc
Gate-Source Forward Voltage (I _G = 1.0 mAdc, V _{DS} = 0)		V _{GS(f)}		1.0	Vdc
Drain-Source On-Voltage (Ip = 3.0 mAdc, V _G S = 0) (Ip = 6.0 mAdc, V _G S = 0) (Ip = 10 mAdc, V _G S = 0)	MFE2004 MFE2005 MFE2006	V _{DS(on)}	=	0.4 0.4 0.4	Vdc
Static Drain-Source On Resistance $(I_D = 1.0 \text{ mAdc}, V_{GS} = 0)$	MFE2004 MFE2005 MFE2006	rDS(on)	=	80 50 30	Ohms

SMALL	-SIGNAL	CHARAC	TERISTICS

Static Drain-Source "ON" Resistance ($V_{GS} = 0$, $I_D = 0$, $f = 1.0$ kHz)	MFE2004 MFE2005 MFE2006	^r ds(on)	Ξ	80 50 30	Ohms
Input Capacitance $(V_{DS} = 0, V_{GS} = -12 \text{ Vdc}, f = 1.0 \text{ MHz})$		C _{iss}	_	16	pF

Characteristic	Characteristic				Unit
Reverse Transfer Capacitance		C _{rss}	2 1		pF
$(V_{DS} = 0, V_{GS} = 6.0 \text{ Vdc}, f = 1.0 \text{ MHz})$	MFE2004		_	5.0	
$(V_{DS} = 0, V_{GS} = 8.0 \text{ Vdc}, f = 1.0 \text{ MHz})$	MFE2005		_	5.0	
$(V_{DS} = 0, V_{GS} = 12 \text{ Vdc}, f = 1.0 \text{ MHz})$	MFE2006		-	5.0	

SWITCHING CHARACTERISTICS						
Turn-On Delay Time $(V_{DD}=3.0\ V_{dc}, I_D=3.0\ mAdc, V_{GS}=0)$ $(V_{DD}=3.0\ V_{dc}, I_D=6.0\ mAdc, V_{GS}=0)$		MFE2004 MFE2005	^t d(on)	-	20 15	ns BUMIXAM
$(V_{DD} = 3.0 \text{ Vdc}, I_{D} = 10 \text{ mAdc}, V_{GS} = 0)$	tinti	MFE2006	Symbol	_	10	
Rise Time $(V_{DD} = 3.0 \text{ Vdc}, I_D = 3.0 \text{ mAdc}, V_{GS} = 0)$		MFE2004	agy t _r	_	40	onudins and
$(V_{DD} = 3.0 \text{ Vdc}, I_{D} = 6.0 \text{ mAdc}, V_{GS} = 0)$ $(V_{DD} = 3.0 \text{ Vdc}, I_{D} = 10 \text{ mAdc}, V_{GS} = 0)$	Vdo	MFE2005 MFE2006	20V	=		struckters
Turn-Off Time			toff		e Current	ns
$(V_{DD} = 3.0 \text{ Vdc}, I_{D} = 3.0 \text{ mAdc}, V_{GS(off)} = 6.0 \text{ Vol} $ $(V_{DD} = 3.0 \text{ Vdc}, I_{D} = 6.0 \text{ mAdc}, V_{GS(off)} = 8.0 \text{ Vol} $ $(V_{DD} = 3.0 \text{ Vdc}, I_{D} = 10 \text{ mAdc}, V_{GS(off)} = 12 \text{ Vdc} $	ic)	MFE2004 MFE2005 MFE2006	gq.	265 = 2670 1 To = 2670		Otal Device Derata ub
	710	1 22 F 1 W1 901		-	THE TO PURCH THE REAL PROPERTY.	TOT THE TURK

^{*}Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 3.0%.

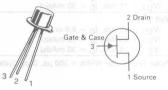
6

	MPE2004 MFE2006 MFE2006		
Ves = 0, tg = 0, f = 1.0 kHz)			

(DID)

CASE 22-03, STYLE 4 TO-18 (TO-206AA)

WII LEVIE



JFET CHOPPER

N-CHANNEL — DEPLETION

Refer to J107 for graphs.

MAXIMUM RATINGS

INDUCTION INTERIOR			
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG}	25	Vdc
Gate-Source Voltage	VGS	25	Vdc
Forward Gate Current	IGF	50	mAdc
Total Device Dissipation @ $T_C = 25^{\circ}C$ Derate above $25^{\circ}C$	PD	1.8 10	Watt mW/°C
Junction Temperature Range	TJ	-65 to +175	°C
Storage Temperature Range	T _{stq}	-65 to +200	°C

Characteristic	Characteristic				Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)		V _(BR) GSS	25	_	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0) (VGS = 15 Vdc, VDS = 0, TA = 150°C)		lgss	=	3.0 6.0	nAdc μAdc
Drain Cutoff Current $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 12 \text{ Vdc})$ $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 12 \text{ Vdc}, T_{A} = 150^{\circ}\text{C})$		I _{D(off)}	_	3.0 6.0	nAdc μAdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current* (VDS = 20 Vdc, VGS = 0)	MFE2010 MFE2011 MFE2012	I _{DSS} *	15 40 100	=	mAdc
Gate-Source Forward Voltage (I _G = 1.0 mAdc, V _{DS} = 0)		V _{GS(f)}	_	1.0	Vdc
Gate-Source Voltage $(V_{DS} = 15 \text{ Vdc}, I_{D} = 1.0 \mu \text{Adc})$	MFE2010 MFE2011 MFE2012	VGS	0.5 1.0 3.0	10 10 10	Vdc
$ \begin{array}{lll} \text{Drain-Source On-Voltage} \\ \text{(ID} &= 8.0 \text{ mAdc, V}_{GS} = 0) \\ \text{(ID} &= 15 \text{ mAdc, V}_{GS} = 0) \\ \text{(ID} &= 30 \text{ mAdc, V}_{GS} = 0) \end{array} $	MFE2010 MFE2011 MFE2012	V _{DS(on)}	=	0.75 0.75 0.75	Vdc
Static Drain-Source On Resistance $(I_D = 1.0 \text{ mAdc}, V_{GS} = 0)$	MFE2010 MFE2011 MFE2012	rDS(on)	Ξ	25 15 10	Ohms
SMALL-SIGNAL CHARACTERISTICS					
Static Drain-Source "ON" Resistance $(V_{GS} = 0, I_D = 0, f = 1.0 \text{ kHz})$	MFE2010 MFE2011 MFE2012	^r ds(on)	=	25 15 10	Ohms
Input Capacitance (V _{DS} = 0, V _{GS} = 10 Vdc, f = 1.0 MHz)		C _{iss}		50	pF
Reverse Transfer Capacitance (V _{DS} = 0, V _{GS} = 12 Vdc, f = 1.0 MHz)		C _{rss}		20	pF

MFE2010, MFE2011, MFE2012

Characteris	Characteristic			Max	Unit
SWITCHING CHARACTERISTICS					
Turn-On Delay Time		t _d (on)	-	10	ns
Rise Time		t _r	_	6.0	ns
Turn-Off Delay Time $ (V_{DD} = 15 \text{ Vdc, I}_D = 8.0 \text{ mAdc}) $ $ (V_{DD} = 15 \text{ Vdc, I}_D = 15 \text{ mAdc}) $ $ (V_{DD} = 15 \text{ Vdc, I}_D = 30 \text{ mAdc}) $	MFE2010 MFE2011 MFE2012	^t d(off)	=	35 20 12	ns
Fall Time (V _{DD} = 15 Vdc, I _D = 8.0 mAdc)	MFE2010	tf		75	ns
(V _{DD} = 15 Vdc, I _D = 15 mAdc) (V _{DD} = 15 Vdc, I _D = 30 mAdc)	MFE2011 MFE2012	agy		45 25	rain-Source

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 3.0%.

MFE9200

CASE 22-03, STYLE 12 TO-18 (TO-206AA)





TMOS SWITCHING

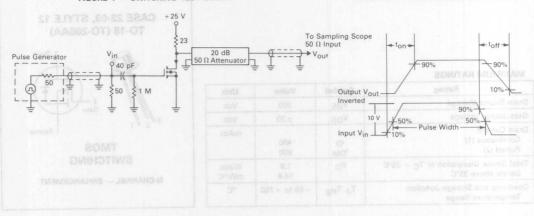
N-CHANNEL — ENHANCEMENT

MAXIMUM RATINGS

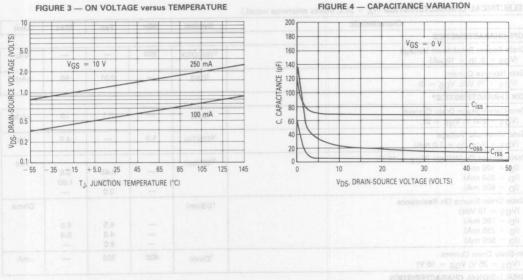
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	200	Vdc
Gate-Source Voltage	VGS	± 20	Vdc
Drain Current Continuous (1) Pulsed (2)	ID IDM	400 800	mAdc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	1.8 14.4	Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

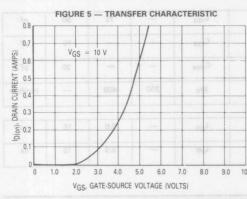
Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (VGS = 0, ID = 10 μ A)	V(BR)DSX	200	V 01 ×	- 195 ·	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0)	IGSS	-	0.01	50	nAdc
ON CHARACTERISTICS*	The second second				
Zero-Gate-Voltage Drain Current (V _{DS} = 200 V, V _{GS} = 0)	IDSS		0.1	10	μAdc
Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 1.0 mA)	V _{GS(Th)}	1.0		4.0	Vdc
Drain-Source On-Voltage (V _{GS} = 10 V) (I _D = 100 mA) (I _D = 250 mA) (I _D = 500 mA)	VDS(on)	aa aa maxmaxayw	0.45 1.20 3.0	0.6 1.60	Vdc
Static Drain-Source On Resistance ($V_{GS}=10~Vdc$) ($I_{D}=100~mA$) ($I_{D}=250~mA$) ($I_{D}=500~mA$)	rDS(on)	=	4.5 4.8 6.0	6.0 6.4	Ohms
On-State Drain Current (Vps = 25 V, Vgs = 10 V)	I _{D(on)}	400	700	-	mA
SMALL-SIGNAL CHARACTERISTICS					
Input Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{iss}	ARARO RO	72	90	pF
Reverse Transfer Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{rss}		V 01	10	pF
Output Capacitance (Vps = 25 V, Vgs = 0, f = 1.0 MHz)	C _{oss}	- \	-	30	pF
Forward Transconductance (Vps = 25 V, lp = 250 mA)	9fs	200	400	-	mmhos
SWITCHING CHARACTERISTICS			N-		401 2
Turn-On Time See Figure 1	ton		6.0	15	ns
Turn-Off Time See Figure 1	toff	-	6.0	15	ns

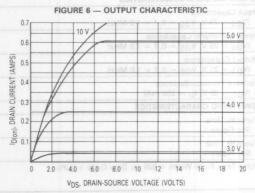
^{*} Pulse Test: Pulse Width \leqslant 300 μ s, Duty Cycle \leqslant 2.0%.

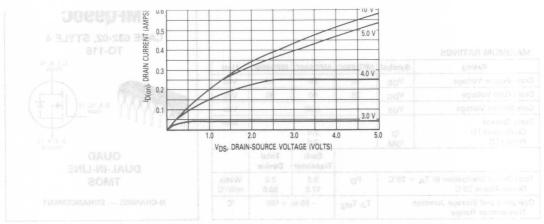








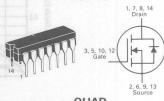




	MFGB30C MFGB90C MFGB90C			
			2.2 2.6 2.6	
SATALL SIGNAL CHARACTERISTICS				
SVITCHING CHARACTERISTICS				

MFQ930C MFQ960C **MFQ990C**

CASE 632-02, STYLE 4 TO-116



QUAD **DUAL-IN-LINE**

N-CHANNEL — ENHANCEMENT

TMOS

Refer to MFE930 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

VDS

 V_{DG}

VGS

ID

IDM

Symbol MFQ930C MFQ960C MFQ990C

60

±30

2.0

3.0

Each

Transistor

0.5

17.0

35

PD

T_J, T_{stg}

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage (VGS = 0, ID = 10 μ A)	MFQ930C MFQ960C MFQ990C	V(BR)DSX	35 60 90	=		Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0)		IGSS		-	50	nAdc

90

90

Total

Device

2.0

66.6

-55 to + 150

Vdc

Vdc

Vdc

Adc

Watts

mW/°C

°C

ON CHARACTERISTICS*

MAXIMUM RATINGS

Drain-Source Voltage

Drain-Gate Voltage

Continuous (1)

Drain Current

Pulsed (2)

Gate-Source Voltage

Rating

Total Device Dissipation @ $T_A = 25^{\circ}C$ Derate Above 25°C

Operating and Storage Junction

Temperature Range

Zero-Gate-Voltage Drain Current (VDS = Maximur	n Rating, $V_{GS} = 0$)	IDSS	_	-	10	μAdc
Gate Threshold Voltage (ID = 1.0 mA, VDS = VGS	3)	V _{GS(Th)}	1.0	-	3.5	Vdc
Drain-Source On-Voltage (VGS = 10 V)		V _{DS(on)}				Vdc
$(I_D = 0.5 \text{ A})$	MFQ930C		-	0.4	0.7	
	MFQ960C		_	0.6	0.8	
	MFQ990C			0.6	1.0	
$(I_D = 1.0 \text{ A})$	MFQ930C			0.9	1.4	
	MFQ960C		_	1.2	1.7	1 19 11
	MFQ990C		_	1.2	2.0	
$(I_D = 2.0 \text{ A})$	MFQ930C		_	2.2	3.0	
	MFQ960C		_	2.8	3.5	
	MFQ990C		_	0.4 0.7 0.6 0.8 0.6 1.0 0.9 1.4 1.2 1.7 1.2 2.0 2.2 3.0		
Static Drain-Source On Resistance		rDS(on)				Ohms
$(V_{GS} = 10 \text{ Vdc}, I_{D} = 1.0 \text{ Adc})$	MFQ930C		_	0.9	1.4	
	MFQ960C		_	1.2	1.7	Land American
	MFQ990C			1.2	2.0	i
On-State Drain Current $(V_{DS} = 25 \text{ V}, V_{GS} = 10 \text{ V})$)	ID(on)	1.0	2.0	11-	Amps
SMALL-SIGNAL CHARACTERISTICS						
I		C.		00	70	

Input Capacitance (Vps = 25 V, Vgs = 0, f = 1.0 MHz)	C _{iss}	T	60	70	pF
Reverse Transfer Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{rss}	-	13	18	pF
Output Capacitance (Vps = 25 V, Vgs = 0, f = 1.0 MHz)	C _{oss}		49	60	pF
Forward Transconductance (V _{DS} = 25 V, I _D = 0.5 A)	9fs	200	380	-	mmhos

SWITCHING CHARACTERISTICS

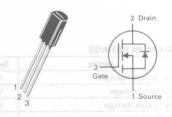
OWITORING OFFICE								
Turn-On Time	ton		7.0	15	ns			
Turn-Off Time	toff	1-11	7.0	15	ns			

MAXIMUM RATINGS

MAXIMOM NATINGS			
Rating	Symbol	Value	Unit
Drain-Source Voltage	VDSS	200	Vdc
Gate-Source Voltage	VGS	± 20	Vdc
Drain Current — Continuous (1) — Pulsed (2)	I _D	400 800	mAdc
Total Power Dissipation @ T _A = 25°C Derate above 25°C	PD	MAM 0.6	Watts mW/°C
Operating and Storage Temperature Range	T _J , T _{stg}	-55 to 150	°C 2
Thermal Resistance Junction to Ambient	θ JA	208	°C/W

MPF89

CASE 29-03, STYLE 7 TO-92 (TO-226AE)



TMOS FET TRANSISTOR

N-CHANNEL - ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Charact	eristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	Indexo2	-	painten and A			
Drain-Source Breakdown Voltage (VG	$S = 0, I_D = 0.5 \text{ mA}$	V _{(BR)DSS}	200		nerott o at na c	Vdc
Zero Gate Voltage Drain Current (VDS = 200 V, VGS = 0)	SSD(RB)V	IDSS	<u>=</u>	0.1	60	μAdc
Gate-Body Leakage Current (VGS = 20 V, V _{DS} = 0)	880	IGSS	<u>-</u>	0.01	100	nAdc
ON CHARACTERISTICS*			(21007 -	g = 0. Tg	- 16 Vdc, Vg	= 39V
Gate Threshold Voltage (Ip = 1.0 mA	$V_{DS} = V_{GS}$	V _{GS(th)}	1.0	- 1998	oV 12.70	Vdc
Drain-Source On-Voltage ($V_{GS} = 10$ ($I_{D} = 100$ mA) ($I_{D} = 300$ mA) ($I_{D} = 500$ mA)	V)	V _{DS} (on)	=	0.45 (56.1.2 S.0 3.0	= gl anv dl = gl 0.6 v sc = gl 1.8 v dl	
On-State Drain Current (V _{DS} = 25 V, V _{GS} = 10 V)	seal	I _{D(on)}	500	700		
Static Drain-Source On-Resistance (V (ID = 150 mA) (ID = 300 mA) (ID = 500 mA)	GS = 10 Vdc)	rDS(on)		4.5	6.0	Ohms
Forward Transconductance (V _{DS} = 2	5 V, I _D = 300 mA)	9fs	140	400	15 VGC, VGS	mmhos
DYNAMIC CHARACTERISTICS	(SM)BH		(+146.8 o	00 - 3 0 -	eometri and also as	must sugn
Input Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MH	Iz) Palyori	C _{iss}	(=).000-0	72	eductarbo	pF
Output Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MH		C _{oss}	Zenathal.	15	eonatio	pF
Reverse Transfer Capacitance (VDS = 25 V, VGS = 0, f = 1.0 MH	(z)	C _{rss}	1-545/1		enster Capal	pF
SWITCHING CHARACTERISTICS*		A900			Poles Width	rent out
Turn-On Time (See Figure 1)		ton	_	6.0	_	ns
Turn-Off Time (See Figure 1)		toff	_	12	_	ns

⁽¹⁾ The Power Dissipation of the package may result in a lower continuous drain current. (2) Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

MPF89

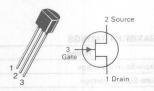
CASE 29-03, STYLE 7 TO 92 (TO 228AE)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	V _{DG}	25	Vdc
Gate-Source Voltage	VGS	- 25	og Vdc
Gate Current	IG	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	200	mW mW/°C
Junction Temperature Range	TJ	125	°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

MPF102

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET VHF AMPLIFIER

N-CHANNEL — DEPLETION

Refer to 2N4416 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

	Characterist	tic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	200	Securety	twin e.n = 01 to = 8	OA) BORDOA	AWOONS IN S	1008-mark
Gate-Source Breakdown Voltage (I _G = -10 μAdc, V _{DS} = 0)		ssai	V _(BR) GSS	- 25	= SDA A GU	Vdc
Gate Reverse Current $(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -15 \text{ Vdc}, V_{DS} = 0, T_A = 0)$	100°C)	889	IGSS		-2.0 -2.0	nAdc μAdc
Gate Source Cutoff Voltage (VDS = 15 Vdc, ID = 2.0 nAdc)	1.0	IntricoV	VGS(off)	Ami 0.L = gi	-8.0	Vdc
Gate Source Voltage (VDS = 15 Vdc, ID = 0.2 mAdc)	-		VGS	- 0.5	-7.5 (Am)	Vdc
ON CHARACTERISTICS	1999				(BUT)	VI 187
Zero-Gate-Voltage Drain Current* (VDS = 15 Vdc, VGS = 0 Vdc)	QUE	(Dion)	IDSS	2.0	20	mAdc
SMALL-SIGNAL CHARACTERISTICS		(me)2G1	199 V 01 - 8E	(V) BONEJelan	THE STUDGE	III. IG OHBI
Forward Transfer Admittance* (VDS = 15 Vdc, VGS = 0, f = 1.0 (VDS = 15 Vdc, VGS = 0, f = 100		327	lyfsl	2000 1600	The second second	μmhos
Input Admittance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 100) MHz)		Re(y _{is})	Teom	800	μmhos
Output Conductance (VDS = 15 Vdc, VGS = 0, f = 100) MHz)	zei ³	Re(yos)	$dM.0.\overline{I} = 1.$	200	μmhos
Input Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0	MHz)	2800	Ciss	HM 0.T = 1.	7.0	pF
Reverse Transfer Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0	MHz)	8810	C _{rss} (s	90 0.T = 1.	3.0	pF

^{*}Pulse Test: Pulse Width ≤ 630 ms; Duty Cycle ≤ 10%.

MPF8.20

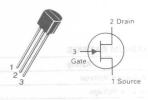
CASE 29-04, STYLE 5

MAXIMUM RATINGS

MAXIMOM NATINGO			
Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	± 30	Vdc
Drain-Gate Voltage	V _{DG}	30	Vdc
Reverse Gate-Source Voltage	VGSR	30 X 30	Vdc Vdc
Forward Gate Current	IG(f)	DOAM 10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.73	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	= 65 to +150	or elec

MPF256

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET AMPLIFIER

N-CHANNEL — DEPLETION

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteris	tic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					newthalf au	and the substitute of	
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)	SSUNA)*		V _(BR) GSS	25	117	o en Current	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0)	5861		IGSS	_	(0 = g	5.0	nAdc
Gate Source Cutoff Voltage $(V_{DS} = 15 \text{ Vdc}, I_{D} = 200 \mu \text{Adc})$	1110/617		V _{GS(off)}	0.5	- 2 90 pAde	7.5	Vdc
ON CHARACTERISTICS		T T T T T T T T T T T T T T T T T T T			en en en en en en en en en en en en en e	out and they	and Lowest
Zero-Gate-Voltage Drain Current (V _{DS} = 15 Vdc, V _{GS} = 0)	iaty.	Red Green Violet	IDSS*	3.0 6.0 11	ACTERIST	7.0 13 18	mAdc
SMALL-SIGNAL CHARACTERISTICS			and the second second	(5000 0.0	= 1.0 = 5	DA GOA GI	8217
Forward Transfer Admittance (V _{DS} = 15 Vdc, V _{GS} = 0, f = 1.0 kHz)	SaiD		Yfs (stell	6.0	obAm 01 =	gl ,abV 21	mmhos
Input Capacitance (VDS = 15 Vdc, ID = 10 mAdc, f = 1.0 M	IHz)		C _{iss}	V 0.1 = 1	3.0	gi Vdc, ig	pF
Reverse Transfer Capacitance $(V_{DS} = 15 \text{ Vdc}, I_{D} = 10 \text{ mAdc}, f = 1.0 \text{ N}$	IHz)		C _{rss}	1-001 = 1	1.2	Gl 'obA gt	pF
Output Capacitance (V _{DS} = 15 Vdc, I _D = 10 mAdc, f = 1.0 kl	Hz)		Coss	1 - 100.1	2.0	15 Vdc, ID	pF
FUNCTIONAL CHARACTERISTICS	ptY		1,410	Hones A	d Hansadir	TENVIOR BREE	AMBITIT OF
Noise Figure $(V_{DS} = 15 \text{ Vdc}, R_S = 50 \text{ Ohms})$	Bix	100 MHz 400 MHz	NF (xH)		nibsansıT e - 10 mAdi.		dB
Common Source Power Gain (V _{DS} = 15 Vdc, R _S = 50 Ohms)	280 ⁽³⁾	100 MHz 400 MHz	G _{ps}	20		TS Vdc. ID	dB

^{*}To characterize these devices to narrower limits, the entire production lot is tested and divided into color-coded groups, with each color dot representing an IDSS range.

When packaged for shipment, the colors are randomly selected and no specific color distribution is implied or guaranteed.

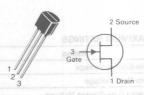
WPF256 CASE 29-04, STYLE TO-92 (TO-226AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	abV 25 0	Vdc
Drain-Gate Voltage	V _{DG}	25	16 Vdc
Reverse Gate-Source Voltage	VGSR	obV 25	Vdc
Forward Gate Current	IG(f)	mAm 10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625 5.0	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +150	or g _o C

MPF820

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



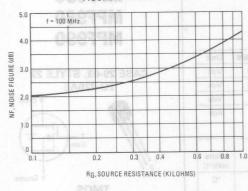
JFET RF AMPLIFIER

N-CHANNEL - DEPLETION

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Gate-Source Breakdown Voltage (I _G = 10 μAdc, V _{DS} = 0)	ASTV	V(BR)GSS	25	wn Voltage	obstans so	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0)	el .	IGSS		10.40	5.0	nAdc
Gate Source Cutoff Voltage (VDS = 15 Vdc, ID = 200 μAdc)		VGS(off)	-	egatic	5.0	Vdc
ON CHARACTERISTICS				atieną uva	anningstown (0.0 1/2 1/20
Zero-Gate-Voltage Drain (VDS = 15 Vdc, VGS = 0)	101	IDSS	10	meruO nin	Voltage Dr	mAdc
SMALL-SIGNAL CHARACTERISTICS	Green			No. of	B	CALL
Forward Transfer Admittance (VDS = 15 Vdc, VGS = 0, f = 1.0 kHz)	Violet	Yfs	- 80	20	AND JAVIO	mmhos
Input Capacitance (VDS = 15 Vdc, ID = 10 mAdc, f = 1.0 MHz)	WI WI	C _{iss}	(skii 0		ranst or Adio	r pFior
Reverse Transfer Capacitance (V _{DS} = 15 Vdc, I _D = 10 mAdc, f = 1.0 MHz)	0	C _{rss}	M.C.1 = 1	3.5	ionario 15 Vde, les	egeopFqn = 8oV)
Common-Gate Input Conductance (VDS = 15 Vdc, ID = 10 mAdc, f = 100 MHz)	9	9ig	M 0.0 = 1	16 mm	gnå mi lans gl.jabV år	mmhos
Common-Gate Output Conductance (VDS = 15 Vdc, ID = 10 mAdc, f = 100 MHz)	0	Gog		phAm 0f =	api16ripso	μmhos
Common-Gate Forward Transadmittance (V _{DS} = 15 Vdc, I _D = 10 mAdc, f = 100 MHz)		Yfg	-	ao, 1218 ma	ARAHS JAJ	mmhos
Common-Gate Reverse Transadmittance (V _{DS} = 15 Vdc, I _D = 10 mAdc, f = 100 MHz)	100 MHz 400 MHz	Yrg	- 1	amdO vä =	an 130	μmhos
Output Capacitance (V _{DS} = 15 Vdc, I _D = 10 mAdc, f = 1.0 kHz)	TRO MHS	Coss	-		Source Powe	pF ₁₀
FUNCTIONAL CHARACTERISTICS	ado MHz					
Noise Figure (VDS = 15 Vdc, ID = 10 mAdc, See Figure 5)	eduction for is terbed and	ng mimoNFU ati	mil 18-cone		4.0	
Small-Signal Power Gain (VDS = 15 Vdc, ID = 10 mAdc, See Figure 5)	d and no specific color o	G _{pg}	ians mo loo	nd .11 mg	da no <u>l h</u> ope	dB





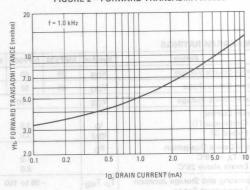
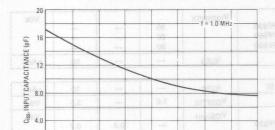
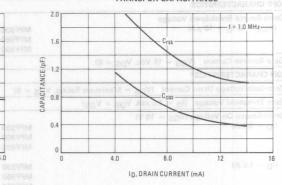


FIGURE 3 - INPUT CAPACITANCE







VGS, GATE-SOURCE VOLTAGE (VOLTS)

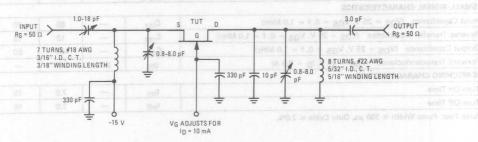
-2.0

-3.0

-1.0

FIGURE 5 - 100 MHz TEST CIRCUIT/ or = 20V W 85 = 20V memu3 disiO atala-no

-4.0



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

MAXIMUM RATINGS

Rating	Symbol	MPF930	MPF960	MPF990	Unit
Drain-Source Voltage	V _{DS}	35	60	90	Vdc
Drain-Gate Voltage	VDG	35	60	90	Vdc
Gate-Source Voltage	VGS		±30		
Drain Current Continuous (1) Pulsed (2)	I _D	2.0 3.0			Adc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	1.0 8.0			Watts mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to 150			°C
Thermal Resistance	θЈΑ	125			°C/W

⁽¹⁾ The Power Dissipation of the package may result in a lower continuous drain current.

MPF930 MPF960 MPF990

CASE 29-03, STYLE 22 TO-226AE



SWITCHING

N-CHANNEL — ENHANCEMENT

Refer to MFE930 for graphs.

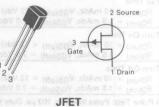
ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage (VGS = 0, ID = 10 μ A)	MPF930 MPF960 MPF990	V _{(BR)DSX}	35 60 90	=	1	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0)		IGSS			50	nAdc
ON CHARACTERISTICS*						1 8
Zero-Gate-Voltage Drain Current (VDS = Maximum Rat	ting, VGS = 0)	IDSS		_	10	μAdc
Gate Threshold Voltage (ID = 1.0 mA, VDS = VGS)	3	VGS(Th)	1.0	_	3.5	Vdc
Drain-Source On-Voltage (VGS = 10 V) (ID = 0.5 A)	MPF930 MPF960 MPF990	V _{DS(on)}		0.4 0.6 0.6	0.7 0.8 1.2	Vdc
$(I_D = 1.0 \text{ A})$ $(I_D = 2.0 \text{ A})$	MPF930 MPF990 MPF930 MPF960	0.8- 12(30V)	0.5- 106 v <u>ou</u> t age	0.9 1.2 1.2 2.2 2.8	1.4 1.7 2.4 3.0 3.5	
	MPF990		_	2.8	4.8	14.64
Static Drain-Source On Resistance $(V_{GS} = 10 \text{ Vdc}, I_D = 1.0 \text{ Adc})$	MPF930 MPF960 MPF990	rDS(on)	Ξ	0.9 1.2 1.2	1.4 1.7 2.0	Ohms
On-State Drain Current $(V_{DS} = 25 \text{ V}, V_{GS} = 10 \text{ V})$	5 - 100 MHz TEST CIR	ID(on)	1.0	2.0	J	Amps
SMALL-SIGNAL CHARACTERISTICS						i ikni
Input Capacitance ($V_{DS} = 25 \text{ V}, V_{GS} = 0, f = 1.0 \text{ MHz}$	101	Ciss	18 81	60	70	pF
Reverse Transfer Capacitance (V _{DS} = 25 V, V _{GS} = 0,	C _{rss}	-	13	18	pF	
Output Capacitance $(V_{DS} = 25 \text{ V}, V_{GS} = 0, f = 1.0 \text{ M})$	Hz)	Coss	\$ - BV	49	60	pF
Forward Transconductance $(V_{DS} = 25 \text{ V}, I_{D} = 0.5 \text{ A})$	9fs	200	380	_	mmhos	
SWITCHING CHARACTERISTICS	1 10000	190				
Turn-On Time		ton		7.0	15	ns
Turn-Off Time	9 8	toff	-1	7.0	15	ns

^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

⁽²⁾ Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



SWITCHING

P-CHANNEL — DEPLETION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Drain-Gate Voltage	VDG	30	Vdc
Reverse Gate-Source Voltage	VGSR	30	Vdc
Forward Gate Current	IG(f)	10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	350 2.8	mW mW/°C
Storage Channel Temperature Range	T _{stg}	-65 to +150	°C
Operating Temperature Range	T _{channel}	-65 to +150	°C

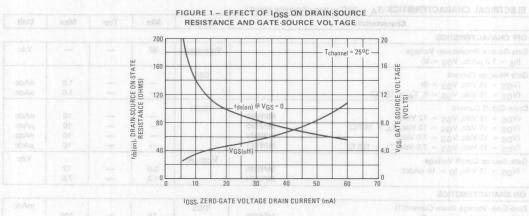
Characteristic DAT JOV 30AU02 377	AD GHA 30	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS		1 1 17	1.000			
Gate-Source Breakdown Voltage (IG = 1.0 µAdc, VDS = 0)		V(BR)GSS	30	-	-	Vdc
Gate Reverse Current (VGS = 15 Vdc, VDS = 0) (VGS = 15 Vdc, VDS = 0, TA = 150°C)		IGSS	PA - PA		1.0 1.0	nAdc μAdc
	PF970 PF970 PF971 PF971	ID(off)	WERE PHEE	Ξ	10 10 10 10	nAdc μAdc nAdc
1.03	PF970 PF971	VGS(off)	5.0	=	12 7.0	Vdc
ON CHARACTERISTICS						
1,09 = 1,00,103	PF970 PF971	DSS	15 2.0	_	100 50	mAdc
Drain-Source On-Voltage	124	V _{DS(on)}			1.5	Vdc

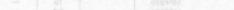
Zero-Gate-Voltage Drain Current(1) (VDS = 20 Vdc, VGS = 0)	MPF970 MPF971	IDSS	15 2.0	_	100 50	mAdc
Drain-Source On-Voltage $(I_D = 10 \text{ mAdc}, V_{GS} = 0)$ $(I_D = 1.5 \text{ mAdc}, V_{GS} = 0)$		V _{DS(on)}	Ξ	=	1.5 1.5	Vdc
Static Drain-Source On Resistance (I _D = 1.0 mAdc, V _{GS} = 0)	MPF970 MPF971	rDS(on)	FOR DEF	NE 2 - TURI	100 250	Ohms

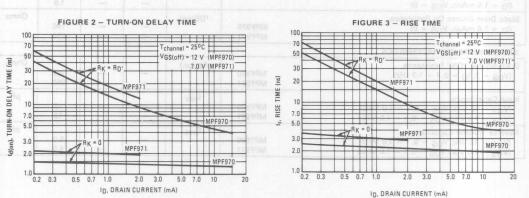
SMALL-SIGNAL CHARACTERISTICS	100	A a laucette				
Drain-Source "ON" Resistance $(V_{GS} = 0, I_{D} = 0, f = 1.0 \text{ kHz})$	MPF970 MPF971	^r ds(on)	T and	on - xn	100 250	Ohms
Input Capacitance (VGS = 12 Vdc, VDS = 0, f = 1.0 MHz) (VGS = 7.0 Vdc, VDS = 0, f = 1.0 MHz)	MPF970 MPF971	Ciss			12 12	pF ²
Reverse Transfer Capacitance (V _{GS} = 12 Vdc, V _{DS} = 0, f = 1.0 MHz) (V _{GS} = 7.0 Vdc, V _{DS} = 0, f = 1.0 MHz)	MPF970 MPF971	C _{rss}	410192	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	5.0 5.0	pF

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

Characteristic			Symbol	Min	Тур	Max	Unit
SWITCHING CHARACTERISTICS (See Figure 6, $R_{K} = 0$)	(1)						
Rise Time $(I_{D(on)} = 10 \text{ mAdc}, V_{GS(off)} = 12 \text{ Vdc})$ $(I_{D(on)} = 1.5 \text{ mAdc}, V_{GS(off)} = 7.0 \text{ Vdc})$		MPF970 MPF971	t _r	Ξ	2.0 3.0	5.0 5.0	ns
Fall Time		MPF970 MPF971	tf	=	9.0 68	15 80	ns
Turn-On Time $(I_{D(on)} = 10 \text{ mAdc}, V_{GS(off)} = 12 \text{ Vdc})$ $(I_{D(on)} = 1.5 \text{ mAdc}, V_{GS(off)} = 7.0 \text{ Vdc})$	sinti-	MPF970 MPF971	t _{on}		3.5 5.0	8.0 10	ns
Turn-Off Time $(I_{D(on)} = 10 \text{ mAdc}, V_{GS(off)} = 12 \text{ Vdc})$ $(I_{D(on)} = 1.5 \text{ mAdc}, V_{GS(off)} = 7.0 \text{ Vdc})$	yde Vde	MPF970 MPF971	^t off	=	13 88	25 120	ns deD
1) Pulse Test: Pulse Width \leq 100 μ s, Duty Cycle \leq 1.0%.	pAm	10	mo!			ste Current	-) brawno

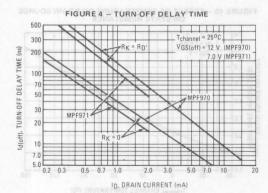






MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





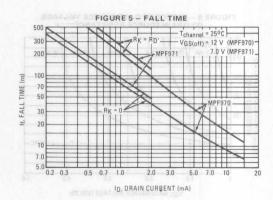
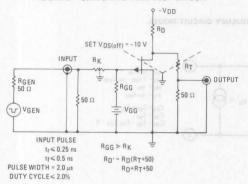


FIGURE 6 - SWITCHING TIME TEST CIRCUIT



NOTE 1

The switching characteristics shown above were measured using a test circuit similar to Figure 6. At the beginning of the switching interval, the gate voltage is at Gate Supply Voltage (+V $_{GG}$). The Drain-Source Voltage (V $_{DS}$) is slightly lower than Drain Supply Voltage (V $_{DD}$) due to the voltage divider. Thus Reverse Transfer Capacitance ($_{C_{rs}}$) or Gate-Drain Capacitance ($_{C_{gd}}$) is charged to V $_{GG}$ +V $_{DS}$.

During the turn-on interval, Gate-Source Capacitance (C_{gs}) discharges through the series combination of R_{Gen} and R_K . C_{gd} must discharge to $V_{DS(on)}$ through R_G and R_K in series with the parallel combination of effective load impedance (R'_D) and Drain-Source Resistance (r_{ds}). During the turn-off, this charge flow is reversed.

Predicting turn-on time is somewhat difficult as the channel resistance r_{ds} is a function of the gate-source voltage. While C_{gs} discharges, V_{GS} approaches zero and r_{ds} decreases. Since C_{gd} discharges through r_{ds} , turn-on time is non-linear. During turn-off, the situation is reversed with r_{ds} increasing as C_{gd} charges.

The above switching curves show two impedance conditions; 1) R_{K} is equal to R_{D} , which simulates the switching behavior of cascaded stages where the driving source impedance is normally the load impedance of the previous stage, and 2) $R_{K}=0$ (low impedance) the driving source impedance is that of the generator.

FIGURE 7 - TYPICAL FORWARD TRANSFER ADMITTANCE

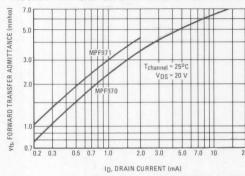
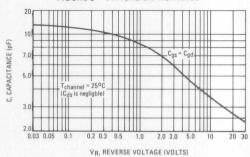


FIGURE 8 - TYPICAL CAPACITANCE



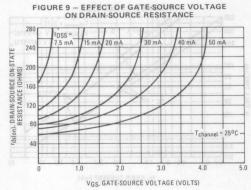
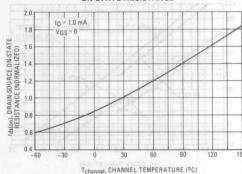
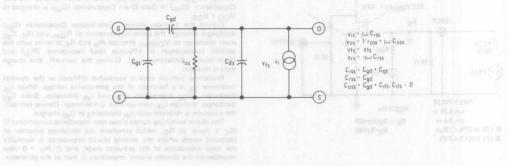
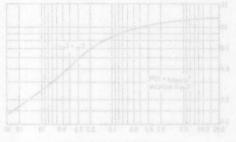


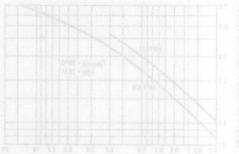
FIGURE 10 — EFFECT OF TEMPERATURE ON DRAIN-SOURCE ON-STATE RESISTANCE



PHT (DDV-) spatioV victoria sted in at section FIGURE 11 – LOW FREQUENCY CIRCUIT MODEL victoria mention section and section section and section and section and section and section section.





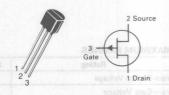


ASE 28-04, STYLE 5 TO-92 (TO-225AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Gate Voltage	V _{DG}	20	Vdc
Gate-Source Voltage	VGS	20	Vdc
Reverse Gate-Source Voltage	VGSR	70Am 20	Vdc
Gate Current	IG	Wm 10	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +150	2° 85 to

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET Series solved and a LOW-FREQUENCY, LOW NOISE

P-CHANNEL — DEPLETION

Refer to 2N5460 for graphs.

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						
Gate-Source Breakdown Voltage (I _G = 10 μA)	edense)*		V _(BR) GSS	20	agy , sta an o	Vdc
Gate Reverse Current (VGS = 10 V)	080		IGSS	= 0. TA =	10	nA,
Gate Source Cutoff Voltage $(V_{DS} = -15 \text{ V}, I_{D} = 10 \mu\text{A})$			VGS(off)	e = 15 Vdc)	6.0	Vdc
ON CHARACTERISTICS		MPF3822				
Zero-Gate-Voltage Drain Current (VDS = -10 V)	sav	MPF3821	IDSS*	2.0	6.0	mA
Drain-Source Resistance (I _D = 100 μA, V _{GS} = 0)		35001100	rDS	Jorga Gi	800	ON CHARA
SMALL-SIGNAL CHARACTERISTICS	620			(T)memo(T)	olisge Drain (V-ers2-oral
Forward Transfer Admittance $(V_{DS} = -10 \text{ V}, I_{D} = 2.0 \text{ mA}, f = 1)$.0 kHz)	MFF 3022	Yfs *	1500	3000	μmhos
Output Admittance $(V_{DS} = -10 \text{ V}, I_{D} = 2.0 \text{ mA}, f = 1)$.0 kHz)		y _{os}	900	40	μmhos
Input Capacitance (Vps = -10 Volts, Vgs = 1.0 Volt	f = 1.0 MHz)	MPF3822	C _{iss}	0.0 = 1,0	20	pF
FUNCTIONAL CHARACTERISTICS		MPF3821	(sHM	0, f = 100	8 Vec. Ves =	14 os = 11
Noise Figure (Vps = -5.0 V, lp = 1.0 mA, Rg =	= 1.0 MΩ)	MF9822	NF		3.0	dB
Pulse Width < 100 ms Duty Cycle < 10%			(SHR	0.1 = 1.0	= 25V DEV 6	8 = 20W

*Pulse Width ≤ 100 ms, Duty Cycle ≤ 10%.

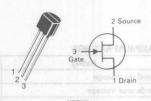
MPF3330

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	HaU 50 \$	Vdc
Drain-Gate Voltage	V _{DG}	50	Vdc
Gate-Source Voltage	VGS	5EV -50	Vdc
Drain Current O.J., YOME U.O. SHAME	ID	36¥ 10	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	Am 310 2.0	mW mW/°C
Junction Temperature Range	TJ	125 S	8.5 °C
Storage Temperature Range	T _{stg}	-65 to 150	ot 95.C

MPF3821 MPF3822

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET GENERAL PURPOSE

N-CHANNEL — DEPLETION

Refer to 2N4220 for graphs.

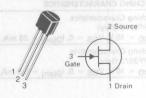
ELECTRICAL	CHARACTERISTICS	(TA =	= 25°C unless	otherwise noted.)
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	Characteristic	American distribution	Symbol	Min	Max	Unit
OFF CHARACTERISTICS	some					
Gate-Source Breakdown Voltage (I _G = -1.0 μAdc, V _{DS} = 0)	SEB(RB)V		V _(BR) GSS	-50 agaileV	nyvobilseni	Vdc
Gate Reverse Current $(V_{GS} = -30 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = -30 \text{ Vdc}, V_{DS} = 0, T_A = 0)$	150°C)		IGSS	=	-0.1 -100	nAdc
Gate Source Cutoff Voltage (I _D = 0.5 nAdc, V _{DS} = 15 Vdc)	MolSSA	MPF3821 MPF3822	VGS(off)	98 0 µA <u>1</u>	= 4.0 - 6.0	Vdc
Gate Source Voltage $(I_D = 50 \mu Adc, V_{DS} = 15 Vdc)$ $(I_D = 200 \mu Adc, V_{DS} = 15 Vdc)$	"eaqi	MPF3821 MPF3822	V _G S	-0.5 -1.0	-2.0 -4.0	Vdc
ON CHARACTERISTICS	oñ,				= apV A	100
Zero-Gate-Voltage Drain Current(1) $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0)$	*[atv]	MPF3821 MPF3822	IDSS	0.5 2.0		mAdc
SMALL-SIGNAL CHARACTERISTICS			10,000			Control washing
Forward Transfer Admittance (VDS = 15 Vdc, V _{GS} = 0, f = 1.0	kHz)(1)	MPF3821 MPF3822		1500 3000	4500 6500	μmhos
$(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 100)$) MHz)	MPF3821 MPF3822		1500 3000	. CILABACT	UNG TIONAL
Output Admittance(1) $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, f = 1.0)$	kHz)	MPF3821 MPF3822	Yos	i.0 mA, Rg sky Cycle ≤	10 20	
Input Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0	MHz)		C _{iss}	-	6.0	pF
Reverse Transfer Capacitance (VDS = 15 Vdc, VGS = 0, f = 1.0	MHz)		C _{rss}	_	3.0	pF
FUNCTIONAL CHARACTERISTICS						
Noise Figure $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 0, R_S = 1 \text{ f} = 10 \text{ Hz}, \text{ Noise Bandwidth} = 5.0 \text{ Noise Bandwidth} $		h train	NF	_	5.0	dB
Equivalent Input Noise Voltage (VDS = 15 Vdc, VGS = 0, f = 10	Hz, Noise Bandw	idth = 5.0 Hz)	e _n	-	200	nv/Hz ^{1/2}

(1) Pulse Test: Pulse Width ≤ 100 ms, Duty Cycle ≤ 10%.

MPF3970 MPF3972

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET SWITCHING

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

W V V V V V V V V V V V V V V V V V V V			
Rating	Symbol	Value	Unit
Drain-Source Voltage —	V _{DS}	40	Vdc
Drain-Gate Voltage	V _{DG}	40	Vdc
Reverse Gate-Source Voltage	VGSR	-40	Vdc
Forward Gate Current	IGF	50	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	-65 to +150	°C

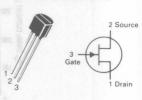
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage ($I_G = 1.0 \mu A$, $V_{GS} = 0$)		V(BR)GSS	40		Vdc
Drain-to-Gate Leakage (V _{DG} = 20 V, I _S = 0)		IDGO		250	pA
Gate Reverse Current (VGS = 20 V, VDS = 0)		IGSS	Hā	250	pA
Gate Source Cutoff Voltage $(V_{DS} = -20 \text{ V}, I_D = 1.0 \text{ nA})$	MPF3970 MPF3972	VGS(off)	-4.0 -0.5	- 10 - 3.0	Vdc
Drain Source Voltage (VGS = 0) (ID = 20 mA) (ID = 5.0 mA)	MPF3970 MPF3972	V _G s		1.0 2.0	Vdc
Drain Cutoff Current $(V_{DS} = 20 \text{ V, } V_{GS} = -12 \text{ V})$		ID(off)		250	pA
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current $(V_{DS} = 20 \text{ V}, V_{GS} = 0)$	MPF3970 MPF3972	I _{DSS}	50 5.0	150 30	mA
Drain-Source "ON" Resistance $(I_D = 1.0 \text{ mA}, V_{GS} = 0)$	MPF3970 MPF3972	rDS(on)	Ξ	30 100	Ω
Input Capacitance (V _{DS} = 20 V, V _{GS} = 0, f = 1.0 MHz)		C _{iss}		25	pF
Reverse Transfer Capacitance (V _{DS} = 0, V _{GS} = -12 V, f = 1.0 MHz)		C _{rss}	-	6.0	pF
FUNCTIONAL CHARACTERISTICS					
Drain-Gate Leakage $(V_{DG} = 20 \text{ V, } I_{S} = 0, T_{A} = 150^{\circ}\text{C})$		IDGO	-	500	nA
Drain Cutoff Current (V _{DS} = 20 V, V _{GS} = -12 V, T _A = 150°C)		ID(off)		500	nA

Characteristic			Symbol	Min	Max	Unit
	MPF3970 MPF3972		^r ds(on)	=	30 100	Ω
SWITCHING CHARACTERISTICS						
Switching Characteristics (MPF3970 Only) (V _{DD} = 10 V, V _{GS} = 0, I _{D(on)} = 20 mA, V _{GS(off)}	= 10 V)		td(on) t _r	_	10 10 30	ns In the system
Switching Characteristics (MPF3972 Only) (Vpp = 10 V, Vgs = 0, Ip(on) = 5.0 mA, Vgs(off)	= 3.0 V)		td(on)	=	40 40 100	ns semo8-niar
nisid Maria C	Vde	Oth	adV		egall	raig-Cate Vo
SWITCHING						

Charact			
FF CHARACTERISTICS			
rainno-Gare Leakaga (Voc. = 20 V, IS = 0)			
N CHARACTERISTICS			

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	-40	Vdc
Drain-Gate Voltage	V _{DG}	-40	Vdc
Gate Current	IG	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	300 2.0	mW mW/°C
Storage Channel Temperature Range	T _{stg}	-65 to +125	°C

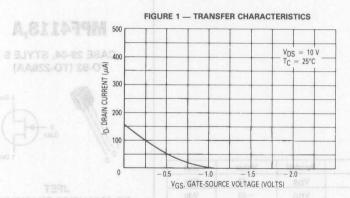
JFET DC AMPLIFIER TRANSISTOR

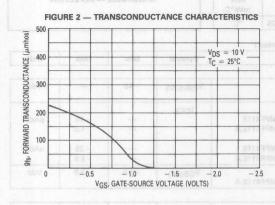
N-CHANNEL — DEPLETION

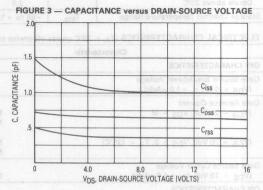
ELECTRICAL CHARACTERISTICS (TA =	25°C unless otherwise noted.)
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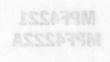
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS	1 2				- 1 8
Gate-Source Breakdown Voltage (V _{DS} = 0, I _G = -1.0 μAdc)	ar S	V _(BR) GSS	-40		Vdc
Gate Reverse Current (V _{GS} = 20 Vdc, V _{DS} = 0)	MPF4118 MPF4118,A	IGSS		-10 -1.0	pAdc
$(V_{GS} = 20 \text{ Vdc}, V_{DS} = 0, T_{A} = 125^{\circ}\text{C})$	MPF4118 MPF4118,A		4	- 25 - 2.5	nAdc
Gate Source Cutoff Voltage (V _{DS} = 10 Vdc, I _D = 1.0 nAdc)	MPF4118,A	VGS(off)	-1.0	-3.0	Vdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(1) (VDS = 10 Vdc, VGS = 0)	MPF4118,A	IDSS	0.08	0.24	mAdc
SMALL-SIGNAL CHARACTERISTICS					
Input Capacitance ($V_{DS} = 10 \text{ Vdc}$, $V_{GS} = 0$, $f = 1.0 \text{ MHz}$)		C _{iss}	-	3.0	pF
Reverse Transfer Capacitance ($V_{DS} = 10 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ MHz}$)		C _{rss}	-	1.5	pF
Common-Source Forward Transconductance $(V_{DS} = 10 \text{ Vdc}, V_{GS} = 0, f = 1.0 \text{ kHz})$	MPF4118,A	9fs	80	250	μmhos
Common-Source Output Conductance (V _{DS} = 10 Vdc, V _{GS} = 0, f = 1.0 kHz)	MPF4118,A	gos		5.0	μmhos

⁽¹⁾ IDSS is measured during a 2.0 ms interval 100 ms after power is applied.









TO-92 (TO-228AA)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	tim 150	Vdc
Drain-Gate Voltage	V _{DG}	150	08 Vdc
Drain Current — Continuous Pulsed(1)	I _D	250 500	08 mA
Total Power Dissipation (a T _A = 25°C Derate above 25°C	PD	625 5.0	mW/°C
Operating and Storage	TJ, T _{stg}	-55 to +150	°C 310

⁽¹⁾ The Power Dissipation of the package may result in a lower continuous drain current.

MPF4150

CASE 29-04, STYLE 23 TO-92 (TO-226AA)



TMOS FET TRANSISTOR

N-CHANNEL - DEPLETION

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.) Visiting 22860 D788 A ATT 208721A345 ARAHO LADRITOR IS

tinD xsM olM Ch	aracteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					SOLEHERS	ARANO RE
Breakdown Voltage Drain to Source $(V_{GS} = -10 \text{ V}, I_D = 10 \mu\text{A})$	SSO(88)V		V _{(BR)DSX}	- 150	Brea <u>ld</u> own b LuA, V _{DS} = 1	Vdc
Gate-Source Cutoff Voltage (VDS = 3.5 V, ID = 1.0 μ A)	essi less		VGS(off)	-1.0	6.0	Vdc
Gate Reverse Leakage (VGS = -20 V, VDS = 0)			IGSS		1.0 = 0.1	
ON CHARACTERISTICS		ASSETTED				
Zero-Gate Voltage Drain Current(2) (VDS = 10 V, VGS = 0)	Yes	MPPASZS	IDSS	- 100	-800	mAdc
Static Drain-Source On-Resistance (VGS = 0 V, ID = 100 mA)			rDS(on)		23/12	Ohms
SMALL-SIGNAL CHARACTERISTICS		recardas.			Volta Viza -	
Forward Transadmittance(2) (VDS = 10 V, ID = 50 mA, f = 1.0	kHz)	MPF4222A	Yfs	100	ARARACI	mmhos
Input Capacitance $(V_{DS} = 10 \text{ Vdc}, V_{GS} = -10 \text{ V, f} =$	1.0 MHz)	100000000000000000000000000000000000000	C _{iss}		125	pF
Reverse Transfer Capacitance $(V_{DS} = 10 \text{ V}, V_{GS} = -10 \text{ V}, f = 1.$	0 MHz)		C _{rss}		15 except	pF
2) Pulse Width ≤ 300 μs, Duty Cycle ≤	2.0%.	MPF4221 MPF1222A	(V)	iz, Vos = 0	bl(0,l) = f(V)	st. = SGA

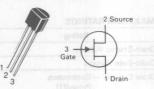
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDS	30	Od Vdc
Drain-Gate Voltage	V _{DG}	30	Vdc
Gate-Source Voltage	VGS	30	Vdc
Reverse Gate-Source Voltage	VGSR	30	Vdc
Gate Current	IG	10	mA
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	310 2.82	mW mW/°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

MPF4221 MPF4222A

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET LOW-FREQUENCY

N-CHANNEL — DEPLETION

Refer to 2N4220 for graphs.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

haracteristic		Symbol	Min	Max	Unit
				earreines:	BARAHO TH
X3G(R8)V		V _(BR) GSS	-30 os	olage Draid	Vdc
(no)30V		IGSS	— eg (Au	ario = 100	pA
tess	MPF4221 MPF4222A	VGS(off)	= 40	-6.0 -8.0	Vdc
ssa,	MPF4221 MPF4222A	VGS	-1.0 -2.0	-5.0 -6.0	Vdc
(90)801 -			gansisise A A		
. Ws	MPF4221 MPF4222A	IDSS*		+ 15	
		(314	1 18.1 - 1 1861	Ap Chin	an Start
0 V)	MPF4221 MPF4222A	Yfs *	2000 2500	5000 6000	μmhos
	MPF4221 MPF4222A	Yos	10 V.1 = 1. Juty Cy cle = —	20 40	μmhos
		C _{iss}	-	6.0	pF
		C _{rss}		2.0	pF
			THE STATE OF		
0 ΜΩ)		NF	-	2.5	dB
	VGS(off) 1055 1055	MPF4221 MPF4221 MPF4222A MPF4221 MPF4222A O V) MPF4221 MPF4222A O V) MPF4221 MPF4222A	V(BR)GSS IGSS VGS(off) WPF4221 WPF4222A VGS WPF4221 MPF4222A IDSS* WPF4222A WPF4222A WPF4222A WPF4222A WPF4222A WPF4222A VGS WPF4222A WPF4222A VGS WPF4222A VGS WPF4222A VGS WPF4222A VGS WPF4222A VGS VGS WFF4222A VGS V(BR)GSS -30	V(BR)GSS -30	

^{*}Pulse Width \leqslant 100 ms, Duty Cycle \leqslant 10%.

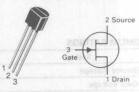
MPF4391 MPF4392 MPF4393

MAXIMUM RATINGS

MAXIMOM HATINGO			
Rating	Symbol	Mall Value	Unit
Drain-Source Voltage	V _{DS}	30	Vdc
Drain-Gate Voltage	V _{DG}	aby 30	Vdc
Drain Current	ID	aby 20	mA
Gate Current	IG	10	mA
Total Device Dissipation @ $T_A = 25^{\circ}C$ Derate above $25^{\circ}C$	PD	300	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	01 91°C 4

MPF4223 MPF4224

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET HIGH-FREQUENCY AMPLIFIER

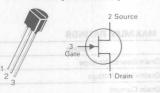
N-CHANNEL - DEPLETION

	Characte	ristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS						AU LENGTIUS	URANU SE
Gate-Source Breakdown Voltage (IG = $-10 \mu A$)	30	SSB(GB)V		V(BR)GSS	-30	areakdown pAdd, Vos-	Vdc
Gate 1 Leakage Current (VG1S = -20 V)		1655	MPF4223 MPF4224	IG1SS	$= \frac{0}{0} = 10$	0.25 0.50	nA
Gate Source Cutoff Voltage (I _D = 0.25 nA, V _{DS} = 15 V) (I _D = 0.5 nA, V _{DS} = 15 V)		(No)G [†]	MPF4223 MPF4224	VGS(off)	-0.1 -0.1	-8.0 -8.0	Vdc
Gate Source Voltage (I _D = 0.3 mA, V _{DS} = 15 V) (I _D = 0.2 mA, V _{DS} = 15 V)	4.0 2.0	SDA	MPF4223 MPF4224	VGS	-1.0 -1.0	-7.0 -7.5	Vdc
ON CHARACTERISTICS	77,0		Sugar Enna			armanami	ARAHO III
Zero-Gate-Voltage Drain Current (V _{DS} = 15 V)	68	saul	MPF4223 MPF4224	IDSS	3.0 2.0	18 20	mA T = 20V)
SMALL-SIGNAL CHARACTERIST	ics		MPRASES				
Forward Transfer Admittance (V _{DS} = 15 V, V _{GS} = 0 V, f =	1.0 kHz)	Vestoni	MPF4223 MPF4224	Yfs	3000 2000	441.00	μmhos
Output Conductance (VDS = 15 V, VGS = 0 V, f =	200 MHz)	(martie)	MPF4393	Re(yos)	= (t) = earstance	200	μ mhos
Input Capacitance (VDS = 15 V, VGS = 0 V, f =	1.0 MHz)		MPF4391 MPF4392	C _{iss}	_ (0. =	6.0	pF
Reverse Transfer Capacitance (VDS = 15 V, VGS = 0 V, f =	1.0 MHz)		MEPAJJS	C _{rss}	CTERISTICS	2.0	pF
FUNCTIONAL CHARACTERISTIC	s	Letvi			ance	stimbA refer	ST DIGWE
Noise Figure $(V_{DS} = 15 \text{ V}, V_{GS} = 0 \text{ V}, R_{G})$	= 1.0 kΩ, f	= 200 MHz)	MPF4223 (Only)	NF O.	5 made, t =	5.0	dB
Common Source Power Gain (VDS = 15 V, VGS = 0 V, f =	200 MHz)	(dolab)	MPF4223 (Only)	G _{ps}	10	Back Street Back Street Co.	dB

MPF4223 MPF4224

MPF4391 MPF4392 MPF4393

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET SWITCHING

N-CHANNEL — DEPLETION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	515V 30	© Vdc
Drain-Gate Voltage	V _{DG}	obV 30	€ Vdc
Gate-Source Voltage	VGS	Am 30	Vdc
Forward Gate Current	IG(f)	Am 50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	625	mW mW/°C
Operating and Storage Channel Temperature Range	T _{channel} , T _{stg}	-65 to +150	or 4%°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

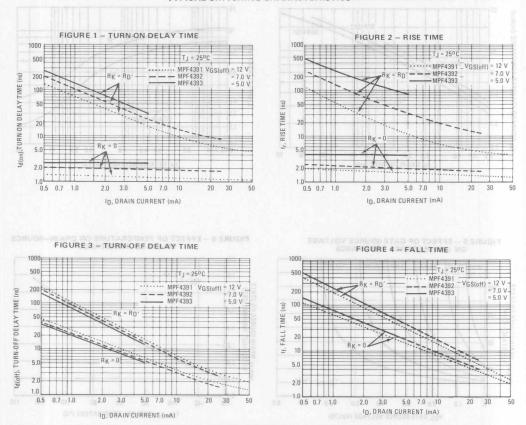
Char	acteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					20	ACTERIST	OFF CHAIR
Gate-Source Breakdown Voltage (I _G = 1.0 μAdc, V _{DS} = 0)	V(BR)GSS		V(BR)GSS	30	uged ial V nw	ce B re akdor 10 _{Jt} A)	
Gate Reverse Current $(V_{GS} = 15 \text{ Vdc}, V_{DS} = 0)$ $(V_{GS} = 15 \text{ Vdc}, V_{DS} = 0, T_A = 10)$	00°C)	MPF4223 MPF4224	IGSS	_	_ 10	1.0 - 0.2	75 75 11
Drain-Cutoff Current $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 12 \text{ Vdc})$ $(V_{DS} = 15 \text{ Vdc}, V_{GS} = 12 \text{ Vdc}, T_{AS}$	(no)32V (= 100°C)	MPF4223 MPF4224	ID(off)	=	flage = 1 5 V) = 16 V)	1.0	nAdc
Gate Source Voltage (V _{DS} = 15 Vdc, I _D = 10 nAdc)	VGS	MPF4391 MPF4392 MPF4393	VGS	4.0 2.0 0.5		10 5.0 3.0	
ON CHARACTERISTICS					terminal of	es (3 perention)	Televis and
Zero-Gate-Voltage Drain Current(1) (VDS = 15 Vdc, VGS = 0)	loss	MPF4391 MPF4392	IDSS	60 25	_	130	mAdc
		MPF4393		5.0	IACTERIST	75 30	SELLANIES
Drain-Source On-Voltage (ID = 12 mAdc, VGS = 0) (ID = 6.0 mAdc, VGS = 0)	lety]	MPF4391 MPF4392	V _{DS(on)}	(<u>sH</u>) 0.1	= 1 <u>.V</u> 0 =	0.4 0.4	Vdc
(ID = 3.0 mAdc, VGS = 0)		MPF4393				0.4	Dutput Cor
Static Drain-Source On Resistance (I _D = 1.0 mAdc, V _{GS} = 0)	Ciss	MPF4391 MPF4392 MPF4393	rDS(on)	(wally 005 (s)44(a)	= 1.V0 =		Ohms
SMALL-SIGNAL CHARACTERISTICS	881			(still 0.1		5 V. Ves -	
Forward Transfer Admittance (VDS = 15 Vdc, ID = 60 mAdc, f =	= 1.0 kHz)	MPF4391	Yfs		20	AL CHARA	
$(V_{DS} = 15 \text{ Vdc}, I_{D} = 25 \text{ mAdc}, f = (V_{DS} = 15 \text{ Vdc}, I_{D} = 5.0 \text{ mAdc}, f)$		MPF4392 MPF4393	(sHM GDS =	1.08.0.1	17 12	s v. ves	
Drain-Source "ON" Resistance (VGS = 0, ID = 0, f = 1.0 kHz)	adg	MPF4391	rds(on)	Islaha oos	1 = 1 X 0 +	30	Ohms
		MPF4392 MPF4393		Ξ	=	60 100	
Input Capacitance (VGS = 15 Vdc, VDS = 0, f = 1.0	MHz)		C _{iss}	-	6.0	10	pF

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

a gricu benutation allow avoid Characteristic and production and	Symbol	Min	Тур	Max	Unit
Reverse Transfer Capacitance $(V_{GS} = 12 \text{ Vdc}, V_{DS} = 0, f = 1.0 \text{ MHz})$ $(V_{DS} = 15 \text{ Vdc}, I_{D} = 10 \text{ mAdc}, f = 1.0 \text{ MHz})$	C _{rss}	=	2.5 3.2	3.5	pF
SWITCHING CHARACTERISTICS					
Rise Time (See Figure 2) (ID(on) = 12 mAdc) MPF4391 (ID(on) = 6.0 mAdc) MPF4392 (ID(on) = 3.0 mAdc) MPF4393	t _r		1.2 2.0 2.5	5.0 5.0 5.0	ns
Fall Time (See Figure 4) (VGS(off) = 12 Vdc) MPF4391 (VGS(off) = 7.0 Vdc) MPF4392 (VGS(off) = 5.0 Vdc) MPF4393	tf	= 1.04	7.0 15 29	15 20 35	ns
Turn-On Time (See Figures 1 and 2) (ID(on) = 12 mAdc) MPF4391 (ID(on) = 6.0 mAdc) MPF4392 (ID(on) = 3.0 mAdc) MPF4393	t _{on}	d= 5198 30-18-98	3.0 4.0 6.5	15 15 15	ns De take
Turn-Off Time (See Figures 3 and 4) (VGS(off) = 12 Vdc) MPF4391 (VGS(off) = 7.0 Vdc) MPF4392 (VGS(off) = 5.0 Vdc) MPF4393	^t off	=	10 20 37	20 35 55	ns

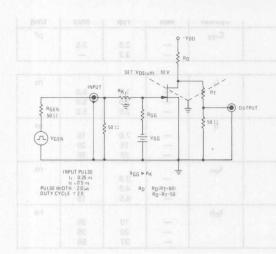
⁽¹⁾ Pulse Test: Pulse Width \leq 100 μ s, Duty Cycle \leq 1.0%.

30/AATIDASAD JADISYT - TTYPICAL SWITCHING CHARACTERISTICS MART GRAMAGE JADISYT - 8 ERUDIS



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS





test circuit similar to Figure 5. At the beginning of the switching interval, the gate voltage is at Gate Supply Voltage ($-V_{GG}$). The Drain-Source Voltage (V_{DS}) is slightly lower than Drain Supply, Voltage (V_{DD}) due to the voltage divider. Thus Reverse Transfer Capacitance (C_{rss}) or Gate-Drain Capacitance (C_{gd}) is charged to $V_{GG} + V_{GG}$

During the turn-on interval, Gate-Source Capacitance (C_{gs}) discharges through the series combination of R_{Gen} and R_K . C_{gd} must discharge to $V_{DS}(on)$ through R_G and R_K in series with the parallel combination of effective load impedance (R_D) and Drain-Source Resistance (r_{ds}). During the turn-off, this charge flow is

Predicting turn-on time is somewhat difficult as the channel resistance r_{ds} is a function of the gate-source voltage. While C_{gs} discharges, V_{GS} approaches zero and r_{ds} decreases. Since C_{gd} discharges through r_{ds} turn-on time is non-linear. During turn-off, the situation is reversed with r_{ds} increasing as C_{gd} charges.

reversed.

The above switching curves show two impedance conditions; 1) R_K is equal to R_D , which simulates the switching behavior of cascaded stages where the driving source impedance is normally the load impedance of the previous stage, and 2) $R_K = 0$ (low impedance) the driving source impedance is that of the generator.



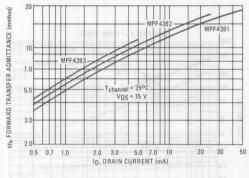


FIGURE 7 - TYPICAL CAPACITANCE

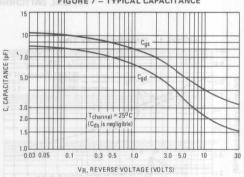


FIGURE 8 - EFFECT OF GATE-SOURCE VOLTAGE

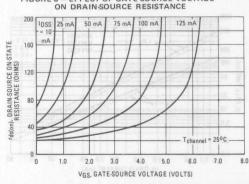
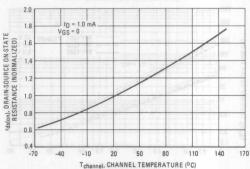
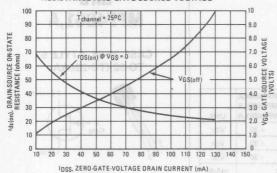


FIGURE 9 - EFFECT OF TEMPERATURE ON DRAIN-SOURCE ON-STATE RESISTANCE



MPF4391, MPF4392, MPF4393





NOTE 2

The Zero-Gate-Voltage Drain Current (IDSS), is the principle determinant of other J-FET characteristics. Figure 10 shows the relationship of Gate-Source Off Voltage ($V_{GS(off)}$) and Drain-Source On Resistance ($r_{GS(onf)}$) to IDSS. Most of the devices will be within $\pm 10\%$ of the values shown in Figure 10. This data will be within ±10% of the values shown in Figure 10. This data will be useful in predicting the characteristic variations for a given part number.

For example:

Unknown

13.0 9

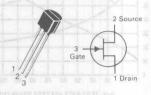
rds(on) and VGS range for an MPF4392

The electrical characteristics table indicates that an MPF4392 has an I_{DSS} range of 25 to 75 mA. Figure 10, shows r_{ds}(on) = 52 Ohms for I_{DSS} = 25 mA and 30 Ohms for I_{DSS} = 75 mA. The corresponding V_{GS} values are 2.2 volts and 4.8 volts.

		Halt

MPF4856,A thru MPF4861,A

CASE 29-04, STYLE 5 TO-92 (TO-226AA)



JFET SWITCHING

N-CHANNEL — DEPLETION

Refer to 2N4856 for graphs.

MAXIMUM RATINGS

Rating	Symbol	MPF4857,A	MPF4859,A MPF4860,A MPF4861,A	Unit
Drain-Source Voltage	VDS	+ 40	+30	Vdc
Drain-Gate Voltage	VDG	+40	+ 30	Vdc
Reverse Gate-Source Voltage	VGSR	-40	-30	Vdc
Forward Gate Current	IGF	5	50	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	360 2.4		mW mW/°C
Storage Temperature Range	T _{stg}	- 65 to	+ 150	°C

ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

Charact	eristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Gate-Source Breakdown Voltage (IG = 1.0 μ Adc, VDS = 0)	MPF4856,A, MPF4857,A, MPF4858,A MPF4859,A, MPF4860,A, MPF4861,A	V _(BR) GSS	- 40 - 30	_	Vdc
. 00		IGSS	Ξ	0.25 0.25 0.5 0.5	nAdc μAdc
Gate Source Cutoff Voltage $(V_{DS} = 15 \text{ Vdc}, I_{D} = 0.5 \text{ nAdc})$	MPF4856,A, MPF4859,A MPF4857,A, MPF4860,A MPF4858,A, MPF4861,A	VGS(off)	-4.0 -2.0 -0.8	-10 -6.0 -4.0	Vdc
Drain Cutoff Current (VDS = 15 Vdc, VGS = -10 Vdc) (VDS = 15 Vdc, VGS = -10 Vdc, TA = 10	150°C)	^I D(off)		0.25 0.5	nAdc μAdc
ON CHARACTERISTICS					
Zero-Gate-Voltage Drain Current(1) (VDS = 15 Vdc, VGS = 0)	MPF4856,A, MPF4859,A MPF4857,A, MPF4860,A MPF4858,A, MPF4861,A	IDSS	50 20 8.0	100	mAdc
Drain-Source On-Voltage (ID = 20 mAdc, V _{GS} = 0) (ID = 10 mAdc, V _{GS} = 0) (ID = 5.0 mAdc, V _{GS} = 0)	MPF4856,A, MPF4859,A MPF4857,A, MPF4860,A MPF4858,A, MPF4861,A	V _{DS} (on)	Ξ	0.75 0.5 0.5	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Drain-Source "ON" Resistance $(V_{GS} = 0, I_D = 0, f = 1.0 \text{ kHz})$	MPF4856,A, MPF4859,A MPF4857,A, MPF4860,A MPF4858,A, MPF4861,A	^r ds(on)	Ξ	25 40 60	Ohms
Input Capacitance $(V_{DS} = 0, V_{GS} = -10 \text{ Vdc}, f = 1.0 \text{ MHz}$) MPF4856 thru MPF4861 MPF4856A thru MPF4861A	C _{iss}	=	18 10	pF
MPF) 4856 thru MPF4861 4856A, MPF4859A 4857A, MPF4858A, MPF4860A, MPF4861A	C _{rss}		8.0 4.0 3.5	pF

MPF4856.A thru MPF4861.A

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C unless otherwise noted.)

	Characteristic		Symbol	Min	Max	Unit
SWITCHING CHAP	RACTERISTICS					
	$\label{eq:conditions} \begin{array}{l} \underline{\text{Conditions for MPF4856,A, MPF4859,A:}} \\ (\text{V}_{DD} = 10 \text{ Vdc, } I_{D(on)} = 20 \text{ mAdc,} \\ \text{V}_{GS(on)} \equiv 0, \text{V}_{GS(off)} = -10 \text{ Vdc)} \\ \end{array}$	MPF4856, MPF4859 MPF4856A, MPF4859A MPF4857, MPF4860 MPF4857A, MPF4860A MPF4858, MPF4861 MPF4858A, MPF4861A	^t d(on)		6.0 5.0 6.0 6.0 10 8.0	ns
Rise Time	Conditions for MPF4857,A, MPF4860,A: (VDD = 10 Vdc, I _{D(on)} = 10 mAdc, VGS(on) = 0, VGS(off) = -6.0 Vdc)	MPF4856,A, MPF4859,A MPF4857,A, MPF4860,A MPF4858, MPF4861 MPF4858A, MPF4861A	tr	=	3.0 4.0 10 8.0	ns MUMIXAN
Turn-Off Time	Conditions for MPF4858,A, MPF4861,A: $(V_{DD} = 10 \text{ Vdc}, I_{D(on)} = 5.0 \text{ mAdc},$ $V_{GS(on)} = 0, V_{GS(off)} = -4.0 \text{ Vdc})$	MPF4856, MPF4859 MPF4856A, MPF4859A MPF4857, MPF4860 MPF4857A, MPF4860A MPF4858, MPF4861 MPF4858A: MPF4861A	agy ^t off	D'es E AT s	25 20 50 40 100 80	rain Source ene Source ete Source ete Curren

⁽¹⁾ Pulse Test: Pulse Width = 100 ms, Duty Cycle ≤ 10%.

⁽²⁾ The ID(on) values are nominal; exact values vary slightly with transistor parameters.



MPF6659 thru 6661 For Specifications, See 2N6659 Data.

U308 U309 U310

CASE 27-02, STYLE 4 TO-52 (TO-206AC)

2 Drain

1 Source



JFET VHF/UHF AMPLIFIER

N-CHANNEL - DEPLETION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	25	Vdc
Gate-Source Voltage	VGS	25 M Tal	Vdc
Gate Current	IG	20	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	PD	500 4.0	mW mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic		Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS				TANJE	- 5-4, 8-7, 7	
Gate-Source Breakdown Voltage ($I_G = 1.0 \mu A, V_{DS} = 0$)	THE SEL	V _(BR) GSS	-25	-		V
Gate Reverse Current $(V_{GS} = -15 \text{ V})$ $(V_{GS} = 0, T_A = 125^{\circ}\text{C})$		IGSS	Ξ		- 150 - 150	pA nA
Gate Source Cutoff Voltage $(V_{DS} = 10 \text{ V}, I_D = 1.0 \text{ nA})$	U308 U309 U310	VGS(off)	- 1.0 - 1.0 - 2.5	=	-6.0 -4.0 -6.0	V
ON CHARACTERISTICS						
Zero-Gate-Voltage Drain Current(1) (VDS = 10 V, VGS = 0)	U308 U309 U310	IDSS	12 12 24	_	60 30 60	mA
Gate-Source Forward Voltage (I _G = 10 mA, V _{DS} = 0)		V _{GS(f)}	_	-	1.0	٧
SWITCHING CHARACTERISTICS						
Common-Gate Forward Transconductance(1) $(V_{DS} = 10 \text{ V}, I_{D} = 10 \text{ mA}, f = 1.0 \text{ kHz})$	U308 U309 U310	9fg	10 10 10	=	20 20 18	mmhos
Common-Gate Output Conductance ($V_{DS} = 10 \text{ V}, I_D = 10 \text{ mA}, f = 1.0 \text{ kHz}$)		9og	1-1	150	-	μmhos
Drain-Gate Capacitance $(V_{GS} = -10 \text{ V}, V_{DS} = 10 \text{ V}, f = 1.0 \text{ MHz})$		C _{gd}	= 1	_	2.5	pF
Gate-Source Capacitance (VGS = -10 V, VDS = 10 V, f = 1.0 MHz)		C _{gs}	-	-	5.0	pF
Equivalent Short-Circuit Input Noise Voltage ($V_{DS} = 10 \text{ V}, I_D = 10 \text{ mA}, f = 100 \text{ Hz}$)		ēn	_	10		nV√Hz

⁽¹⁾ Pulse test duration = 2.0 ms.

⁽²⁾ See Figures 10 and 11 for Noise Figure and Power Gain information.

C3 = C4 = 8 35 pF Erie = 2433 000). C5 = C6 = 5000 pF Erie (2443 000). C7 = 1000 pF. Allen Bradley = FASC. RFC = 0.33 µH Miller = 9230 30. L1 = One Turn = 16 Cu, 1/4" I.D. (Air Core). L2p = One Turn = 16 Cu, 1/4" I.D. (Air Core). L2_S = One Turn = 16 Cu, 1/4" I.D. (Air Core).

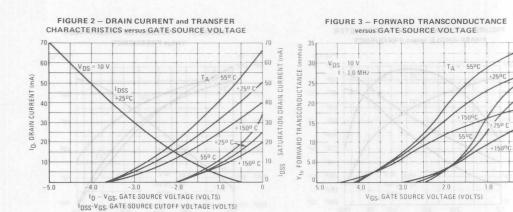
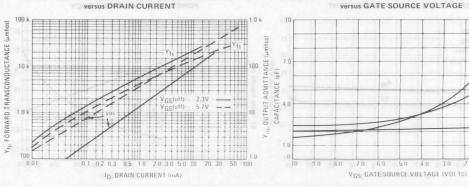


FIGURE 4 – COMMON-SOURCE OUTPUT
ADMITTANCE and FORWARD TRANSCONDUCTANCE
versus DRAIN CURRENT



MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

FIGURE 5 - ON RESISTANCE and JUNCTION CAPACITANCE

20

ON RESISTANCE

RDS

FIGURE 6 – COMMON-GATE Y PARAMETER MAGNITUDE versus FREQUENCY

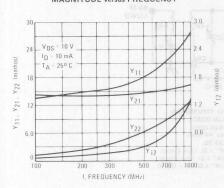


FIGURE 7 – COMMON-GATE S PARAMETER MAGNITUDE versus FREQUENCY

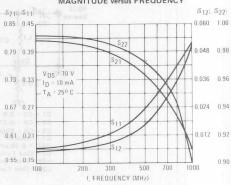


FIGURE 8 – COMMON-GATE Y PARAMETER PHASE-ANGLE versus FREQUENCY

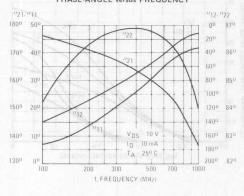


FIGURE 9 - S PARAMETER PHASE-ANGLE

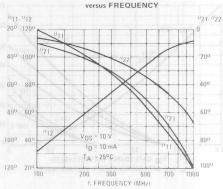


FIGURE 10 – NOISE FIGURE and

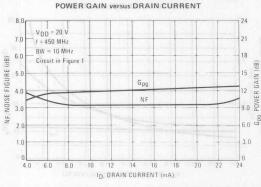


FIGURE 11 – NOISE FIGURE and POWER GAIN versus FREQUENCY

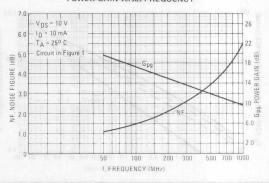
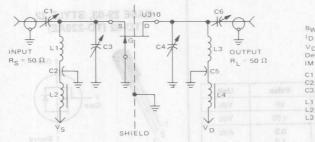


FIGURE 12 - 450 MHz IMD EVALUATION AMPLIFIER



BW (3dB) - 36.5 MHz ID 10 mAdc VDS 20 Vdc

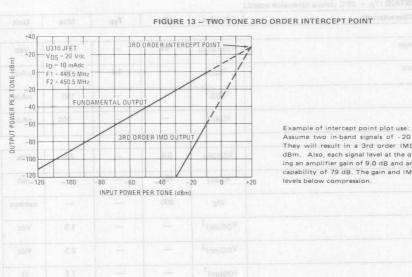
Device case grounded IM test tones – f1 = 449.5 MHz, f2 = 450.5 MHz

C1 = 1-10 pf Johanson Air variable trimmer. All Mall Mill AM

C2, C5 = 100 pf feed thru button capacitor.
C3, C4, C6 = 0.5-6 pf Johanson Air variable trimmer

L1 = 1/8" x 1/32" x 1-5/8" copper bar L2, L4 = Ferroxcube Vk200 choke. L3 = 1/8" x 1/32" x 1 7/8" copper bar.

Amplifier power gain and IMD products are a function of the load impedance. For the amplifier design shown above with C4 and C6 adjusted to reflect a load to the drain resulting in a nominal power gain of 9 dB, the 3rd order intercept point (IP) value is 29 dBm. Adjusting C4, C6 to provide larger load values will result in higher gain, smaller bandwidth and lower IP values. For example, a nominal gain of 13 dB can be achieved with an intercept point of 19 dBm.

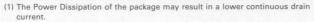


Assume two in-band signals of -20 dBm at the amplifier input. They will result in a 3rd order IMD signal at the output of -90 dBm. Also, each signal level at the output will be -11 dBm, show-

ing an amplifier gain of 9.0 dB and an intermodulation ratio (IMR) capability of 79 dB. The gain and IMR values apply only for signal

MOTOROLA SMALL-SIGNAL SEMICONDUCTORS

Rating	Symbol	Value	Unit
Drain-Source Voltage	VDSS	60	Vdc
Gate-Source Voltage	VGS	± 30	Vdc
Drain Current — Continuous(1) Pulsed(2)	I _D	0.3 1.0	Adc
Total Power Dissipation @ TA = 25°C Derate above 25°C	PD	1.0 and 8.0	Watts mW/°C
Operating and Storage Analysis and Storage Temperature Range		-40 to +150	Hall oC =



(2) Pulse Width \leq 300 $\mu\text{s},$ Duty Cycle.

CASE 29-03, STYLE 22 TO-92 (TO-226AE) TMOS FET TRANSISTOR N-CHANNEL — ENHANCEMENT

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted.)

Characteristic paragraph and an one	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS					1.00
Drain-Source Breakdown Voltage $(V_{GS}=0, I_{D}=100 \mu A)$	V _{(BR)DSS}	60		1230 0121 02 20 Vue	Vdc
Zero Gate Voltage Drain Current (V _{DS} = 45 V, V _{GS} = 0)	IDSS		0.1	10	μAdc
Gate-Body Leakage Current $(V_{GS} = -15 \text{ V}, V_{DS} = 0)$	IGSS ¹		MENO DATATI	100	nAdc
Gate-Body Leakage Current (VGS = 15 V, VDS = 0)	I _{GSS} ²		7	-100	nAdc
ON CHARACTERISTICS 1000 DE 100 DE 1000	1	TALLIE SWITHS			
Gate Threshold Voltage (V _{DS} = V _{GS} , I _D = 1.0 mA)	VGS(th)	0.8		2.5	Vdc
On-State Drain Current (V _{DS} = 15 V, V _{GS} = 10 V)	ID(on)	750	80 - 08 8 - 08	Gir-	mA
Forward Transconductance (V _{DS} = 15 V, I _D = 500 mA)	9fs	200	-	_	mmhos
Drain-Source On-Voltage (VGS = 5.0 V, I _D = 200 mA)	V _{DS(on)} ¹	-	-	1.5	Vdc
Drain-Source On-Voltage (VGS = 10 V, I _D = 500 mA)	V _{DS(on)} ²	-	-	2.5	Vdc
Drain-Source On-Resistance (VGS = 5.0 V, ID = 200 mA)	rDS(on) ¹	-		7.5	Ω
Drain-Source On-Resistance (VGS = 10 V, I _D = 500 mA)	rDS(on) ²			5.0	Ω
Input Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{iss}		-	60	pF
Output Capacitance (V _{DS} = 25 V, V _{GS} = 0, f = 1.0 MHz)	C _{oss}	-	-	25	pF
Reverse Transfer Capacitance ($V_{DS} = 25 \text{ V, } V_{GS} = 0 \text{ V, f} = 1.0 \text{ MHz}$)	C _{rss}	-	-	5.0	pF
Turn-On Time (V _{DS} = 15 V, R _L = 23 Ω , R _G = 50 Ω , V _{in} = 20 V)	ton	-	-	10	ns
Turn-Off Time (Vps = 15 V, R _L = 23 Ω , R _G = 50 Ω , V _{in} = 20 V)	toff	-	-	10	ns

MAXIMUM RATINGS

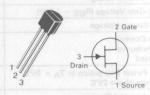
INIAMINIONI NATINGS			
Rating	Symbol	Value 9	Unit
Drain-Source Voltage	VDSS	60	Vdc
Drain-Gate Voltage (RGS = 1 M Ω)	VDGR	60	8 Vdc
Gate-Source Voltage	VGS	± 40	Vdc
Drain Current Continuous Pulsed	I _D	190 1000	mAdc
Total Power Dissipation (a T _A = 25°C Derate above 25°C	PD	400	mW mW/°C
Operating and Storage Temperature Range	TJ, T _{stg}	-55 to +150	of 8d°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Ambient	$R_{\theta JA}$	312.5	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/16" from case for 10 seconds	TL	300	°C

VN0610LL

CASE 29-04, STYLE 22 TO-92 (TO-226AA)



TMOS FET
TRANSISTOR

N-CHANNEL - ENHANCEMENT

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.) "entre seeing 275 = 5TI 20TE/H9T0ARAHO (ADHTOE H

SERU ROM Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Drain-Source Breakdown Voltage (VGS = 0, I _D = 100 μA)	Venipss	V _{(BR)DSS}	60	e Br <u>ea</u> idow 1, lb = 100 g	Vdc
Zero Gate Voltage Drain Current ($V_{DS} = 48 \text{ V}, V_{GS} = 0$) ($V_{DS} = 48 \text{ V}, V_{GS} = 0, T_J = 125 ^{\circ}\text{C}$	820	IDSS	Current 0) 0, T_J = 125f	10 500	μAdc
Gate-Body Leakage Current, Forward (VGSF = 30 Vdc, VDS = 0)		IGSSF	ent, E <u>cr</u> ward = 0)	-100 -100 -100	nAdc
ON CHARACTERISTICS*				contamero	BRAHO //
Gate Threshold Voltage (VDS = VGS	$S, I_D = 1.0 \text{ mA}$	V _{GS(th)}	0.8	2.5	Vdc
Static Drain-Source On-Resistance (VGS = 10 Vdc, I_D = 500 mA) (VGS = 10 Vdc, I_D = 500 mA, T_C =	inot207 = 125°C)	rDS(on)	lesistance 0.6 A <u>do</u>) 0.6 V_IC =	5.0	Ohm
Drain-Source On-Voltage (V _{GS} = 5.0 V, I _D = 200 mA) (V _{GS} = 10 V, I _D = 500 mA)	Vosioni	V _{DS(on)}		1.5 2.5	Vdc
On-State Drain Current (V _{GS} = 10 V, V _{DS} ≥ 2.0 V _{DS(on)})		I _{D(on)}	750	ain Current	mA
Forward Transconductance (V _{DS} ≥ 2.	0 V _{DS(on)} , I _D = 500 mA)	9fs	100	SGA WRA R	μmhos
DYNAMIC CHARACTERISTICS	910			08 = MLV 0	
Input Capacitance		Ciss	BOTTE	60	pF pF
Output Capacitance	$(V_{DS} = 25 \text{ V}, V_{GS} = 0)$ f = 1.0 MHz)	Coss	-	25	sper Caps
Reverse Transfer Capacitance		C _{rss}	-	5.0	asO Juan
SWITCHING CHARACTERISTICS*	(SHM 0.1 - 1		ebrisi	nster Capaci	siT satova
Turn-On Delay Time	$(V_{DD} = 15 \text{ V}, I_{D} = 600 \text{ mA})$	ton	*saras	10	ns
Turn-Off Delay Time	$R_{gen} = 25 \text{ ohms}, R_L = 23 \text{ ohms})$	toff	_	10	NG MO-DE

MAXIMUM RATINGS

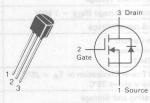
Rating	Symbol	Value ou	Unit
Drain-Source Voltage	V _{DSS}	60	Vdc
Drain-Gate Voltage (RGS = 1 M Ω)	VDGR	60	Vdc
Gate-Source Voltage	VGS	56V ±40	Vdc
Drain Current Continuous Pulsed	I _D	150 1000	mAdc
Total Power Dissipation @ T _A = 25°C Derate above 25°C	PD	400	mW mW/°C
Operating and Storage Temperature Range	TJ, T _{stg}	-55 to +150	o) 88°C

THERMAL CHARACTERISTICS

Thermal Resistance Junction to Ambient	$R_{\theta}JA$	312.5	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/16" from case for 10 seconds	TL	300	°C

VN2222LL

CASE 29-04, STYLE 22 TO-92 (TO-226AA)



TMOS FET

N-CHANNEL - ENHANCEMENT

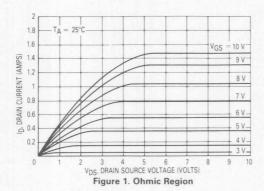
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

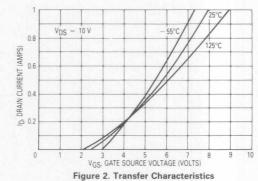
Sints - xxiii Characteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS					BOTTENETTO:	OFF CHARL
Drain-Source Breakdown Voltage (VGS = 0, ID = 100 μA)	eso(ne)V		V(BR)DSS	60	, 15 = 100 V	Vdc /
Zero Gate Voltage Drain Current ($V_{DS} = 48 \text{ V}, V_{GS} = 0$) ($V_{DS} = 48 \text{ V}, V_{GS} = 0, T_{J} = 125^{\circ}\text{C}$	aaol C)		IDSS	Current 0) — 0, TJ — 128 C	10 500	μAdc S
Gate-Body Leakage Current, Forward (VGSF = 30 Vdc, VDS = 0)			IGSSF	ent f u nvard = 0)	- 100 - 100	nAdc
ON CHARACTERISTICS*						
Gate Threshold Voltage (VDS = VG	$S, I_D = 1.0 \text{ mA})$		V _{GS(th)}	0.6	og s 2.5 plan	Vdc 0
Static Drain-Source On-Resistance ($V_{GS} = 10 \text{ Vdc}$, $I_{D} = 0.5 \text{ Adc}$) ($V_{GS} = 10 \text{ Vdc}$, $I_{D} = 0.5 \text{ V}$, $T_{C} = 1 \text{ Vdc}$)	(no)201 25°C)		rDS(on)	kosistance 500 mHJ 800 mHz Tc	7.5 13.5	Ohm
Drain-Source On-Voltage (V _G S = 5.0 V, I _D = 200 mA) (V _G S = 10 V, I _D = 500 mA)	VBS(on)		V _{DS(on)}	TAm 01	1.5 v g s	90V = 30V = 20V
On-State Drain Current (VGS = 10 Vdc, VDS ≥ 2.0 VDS(on) (majal	DS(on))	ID(on)	750 V	an C ur rant	a mA
Forward Transconductance (VDS = 10 V, ID = 500 mA)	378	15.00 5.00	9fs	100	MBTORRAK	μmhos
DYNAMIC CHARACTERISTICS	L sajū	One made VIDC as the	100		90857	page 2 Jugni
Input Capacitance	5800	1 = 1.0 MHzi	Ciss		60	pF
Output Capacitance	$(V_{DS} = 25 \text{ V}, V_{GS} = 0 $ f = 1.0 MHz)		Coss	90(18)	25	nT carsver
Reverse Transfer Capacitance			C _{rss}	18.041808	5.0	MERCHAN
SWITCHING CHARACTERISTICS*	no?	Am 008 = gi N 81 = 1	ga¥)		auni Ac	Tuest Unit 1)6
Turn-On Delay Time	(V _{DD}	= 15 V, I _D = 600 mA	ton		10	ns
Turn-Off Delay Time	R _{gen} = 2	5 ohms, R _L = 23 ohms)	toff	100 and 00E a	10	mae T estuf

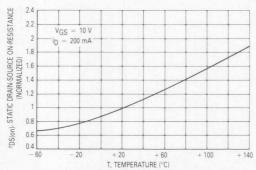
^{*}Pulse Test: Pulse Width \leq 300 μ s, Duty Cycle \leq 2.0%.

 $V_{DS} = V_{GS}$ $I_{D} = 1 \text{ mA}$

+ 140



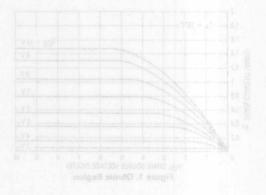


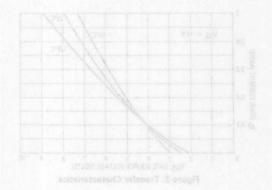


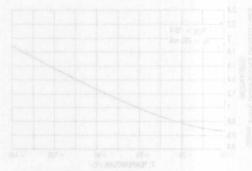
0.7 + 60 + 100 T, TEMPERATURE (°C)

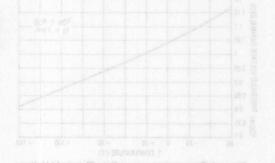
Figure 3. Temperature versus Static Drain-Source On-Resistance

Figure 4. Temperature versus Gate Threshold Voltage





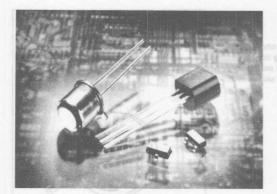




rigure 3, Temperature versus Static Drein-Source On-Resistance

Embossed Tape and Reel

option table below. Note that the individual reals have a finite number of day ces depending as the type of product contained in the tape. Also note the minimum tot size is one full real for each line item, and ciders are required to be in increments of the single reel quantity. Minimum order



Tape and Reel Specifications

		Dayles per Reel	
		3,000	
		3,000	
		2,000	
		1,000 5,000	
		500 2,500	
	13	500 2,500	
		500 2,500	
		1,800	

Embossed Tape and Reel is used to facilitate automatic pick and place equipment feed requirements. The tape is used as the shipping container for various products and requires a minimum of handling. The antistatic/conductive tape provides a secure cavity for the product when sealed with the "peel-back" cover tape.

- Two Reel Sizes Available (7" and 13")
- Used For Automatic Pick and Place Feed Systems
- Minimizes Product Handling
- EIA 481
- MLL-34, SOT-23, SOT-143 in 8 mm Tape
- MLL-41, SO-8 in 12 mm Tape
- DPAK, SO-14, SO-16 in 16 mm Tape

Ordering Information

Use the standard device title and add the required suffix as listed in the option table below. Note that the individual reels have a finite number of devices depending on the type of product contained in the tape. Also note the minimum lot size is one full reel for each line item, and orders are required to be in increments of the single reel quantity. Minimum order \$200.00/line-line.

Tape and Reel
Data for
Discrete
Surface Mount
Devices



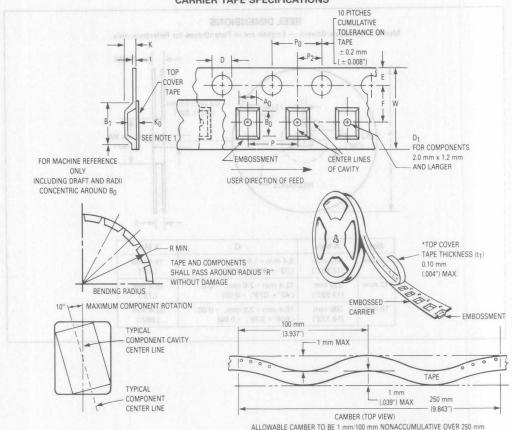
PACKAGES
MLL-34 SO-8
MLL-41 SO-14
SOT-23 SO-16
SOT-143 DPAK

SOT-23	SOT-143	MLL-34
8 mm	8 mm	8 mm
MLL-41	SO-8, 14, 16	DPAK
12 mm	12, 16 mm	16 mm
		DIRECTION

Package	Tape Width (mm)	Device per Reel	Reel Size (inch)	Tape & Reel Lot Size (Min)	Device Suffix
SOT-23	8 8	3,000 10,000	7 13	3,000 10,000	T1 T3
SOT-143	8 8	3,000 10,000	7 13	3,000 10,000	T1 T3
MLL-34	8 8	2,000 5,000	7 13	2,000 5,000	T1 T3
MLL-41	12 12	1,000 5,000	7 13	1,000 5,000	T1 T3
SO-8	12 12	500 2,500	7 13	500 2,500	R1 R2
SO-14	16 16	500 2,500	7 13	500 2,500	R1 R2
SO-16	16 16	500 2,500	7 13	500 2,500	R1 R2
DPAK	16	1,800	13	1,800	RL

TAPE AND REEL DATA FOR DISCRETE SMD

CARRIER TAPE SPECIFICATIONS



ALLOWABLE CAMBER TO BE 1 mm/100 mm NONACCUMULATIVE OVER 250 mm

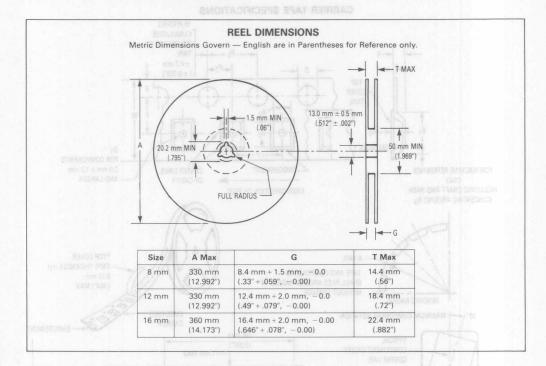
DIMENSIONS

Tape Size	B ₁ Max	D	D ₁	E	F	К	Р	P ₀	P ₂	R Min	T Max	w
8 mm	4.2 mm (.165")	1.5 + 0.1 mm - 0.0 (.059 + .004" - 0.0)	1.0 mm Min (.039")		3.5 ± 0.5 mm (.138 ± .002")	2.4 mm Max (.094")	4.0 ± 0.1 mm (.157 ± .004")		2.0 ± 0.50 mm (.079 ± .002")	25 mm (.98")	0.400 mm (.016")	8.0 ± .30 mm (.315 ± .012"
12 mm	8.2 mm (.323")		1.5 mm Min (.060")		$5.5 \pm 0.5 \text{mm}$ (217 \pm .002")	4.5 mm Max (.177")	4.0 ± 0.1 mm (.157 ± .004") 8.0 ± .01 mm (.315 ± .004")			30 mm (1.18")		12 ± .30 mm (.470 ± .012"
16 mm	12.1 mm (.476")				7.5 ± 0.10 mm (.295 ± .004")	6.5 mm (.256")	4.0 ± 0.1 mm $(.157 \pm .004")$ $8.0 \pm .01$ mm $(.315 \pm .004")$ $12.0 \pm .004$ mm $(.472 \pm .004")$		2.0 ± .010 mm (.079 ± .004")	40 mm (1.575")		16 ± .30 mm (.630 ± .012"

Metric Dimensions Govern — English are in parentheses for reference only.

NOTE 1: A₀, B₀, and K₀ are determined by component size. The clearance between the components and the cavity must be within .05 min. to .50 max., the component cannot rotate more than 10° within the determined cavity.





mm 95 ± 87 (*570 ± 603.)									

or Ammo Pack

Radial tape reel and ammo pack of the reliable TO-92 package are the best methods of capturing devices for automatic insertion in printed circuit boards. These methods of taping are compatible with various equipment for active and passive component insertion.

- · Available on 360 mm Reels
- Available in Ammo Pack (Fan Fold Box)
- Accommodates Various Inserters
- Allows Flexible Circuit Board Layout
- 2.5 mm Pin Spacing For Soldering
- Conforms to EIA ACP Standard 1375 (RS-468)

TAPE REEL OR AMMO PACK



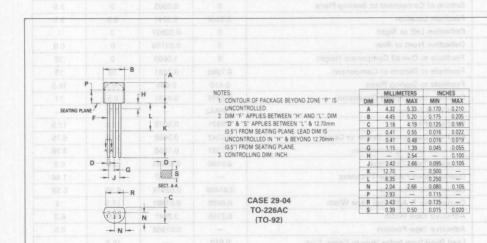
Ordering Notes:

When ordering radial tape on reel or in ammo pack, specify the style per Figures 3 thru 8. Add the suffix "RLR" and "Style" to the device title, i.e. MPS3904RLRA. This will be a standard MPS3904 radial taped and supplied on a reel per Figure 3.

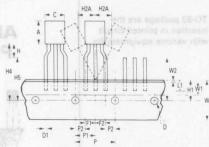
Reel Information — Minimum order quantity 1 Reel/\$200LL.

Order in increments of 2000.

Ammo Pack Information — Minimum order quantity 1 Box/\$200LL Order in increments of 2000.



LANDAR





	, specify the style per	Specification					
	the device title, i.e.	of style Inch	ies and and	Millir	neter		
Symbol	Item ballugus bas begat le	Min Sam	Max	Min Min	Max		
Α	Component Body Height	0.170	0.210	4.32	5.33		
В	Component Body Width	0.125	0.165	3.18	4.19		
С	Component Body Length along Tape	0.1748	0.2052	4.44	5.21		
D	Tape Feedhole Diameter	0.145	0.1693	3.7	4.3		
D1	Component Lead Width Dimension	0.016	0.022	0.41	0.56		
D2	Component Lead Thickness Dimension	0.015	0.020	0.38	0.51		
F1, F2	Component Lead Pitch	0.0945	0.110	2.4	2.8		
Н	Bottom of Component to Seating Plane	0	0.0985	0	2.5		
H1	Feedhole Location	0.3346	0.3741	8.5	9.5		
H2A	Deflection Left or Right	0	0.03937	0	1		
H2B	Deflection Front or Rear	0	0.03150	0	0.8		
НЗ	Feedhole to Overall Component Height	0	1.2600	0	32		
H4	Feedhole to Bottom of Component	0.7086	0.7481	18	19		
H5	Feedhole to Seating Plane	0.610	0.649	15.5	16.5		
L	Defective Unit Clipped Dimension	0.3346	0.4431	8.5	11		
L1	Lead Wire Enclosure	0.09842	- 1	2.5	spr servicia		
Р	Feedhole Pitch	0.4921	0.5079	12.5	12.9		
P1	Feedhole Component Center to Center	0.2342	0.2658	5.95	6.75		
P2	First Lead Spacing Dimension	0.1397	0.1556	3.55	3.95		
Т	Adhesive Tape Thickness	0.0196	0.03544	0.5	0.9		
T1	Overall Taped Package Thickness	_	0.0567		1.44		
T2	Carrier Strip Thickness	0.01496	0.02678	0.38	0.68		
W	Carrier Strip & Adhesive Tape Width	0.6889	0.07481	17.5	19		
W1	Adhesive Tape Width	0.2165	0.2841	5.5	6.3		
W2	Adhesive Tape Position	_	0.01968		0.5		
B5	Lead Bend from Index Hole to Center Line	0.610	_	15.5	_		

- NOTES:

 1. Maximum alignment deviation between leads not to be greater than 0.2 mm.

 2. Defective components shall be clipped from the carrier tape such that the remaining protrusion (L) does not exceed a maximum of 11 mm.

 3. Component lead to tape adhesion must meet the pull test requirements established in Figures 10, 11 and 12.

 4. Maximum non-cumulative variation between tape feed holes shall not exceed 1 mm in 20 pitches.

 5. Holddown tape not to extend beyond the edge(s) of carrier tape and there shall be no exposure of adhesive.

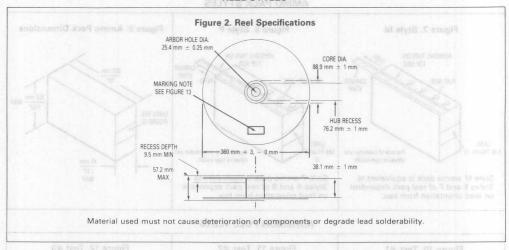
 6. No more than 3 consecutive missing components is permitted.

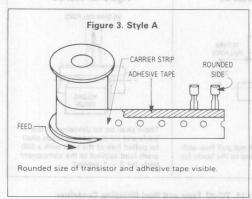
 7. A tape trailer, having at least three feed holes is required after the last component.

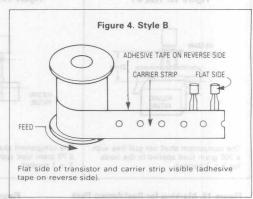
- Splices shall not interfere with the sprocket feed holes

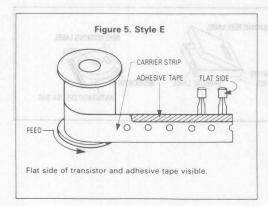
TO-92 EIA RADIAL TAPE REEL OR AMMO PACK

REEL STYLES









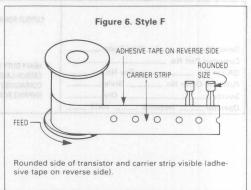


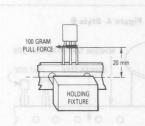
Figure 8. Style P ADHESIVE TAPE ON STRIP FEED ROUNDED SIDE LABEL SEE FIGUR Rounded side of transistor a 13 adhesive tape visible. Style P ammo pack is equivalent to Styles A and B of reel pack dependent on feed orientation from box.

Figure 9. Ammo Pack Dimensions 252 mm MAX 9.92" LABEL SEE FIGURE 13 1.77" MAX

ADHESION PULL TESTS

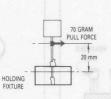
Figure 10. Test #1

on feed orientation from box.



The component shall not pull free with a 300 gram load applied to the leads for 3 ± 1 second.

Figure 11. Test #2



The component shall not pull free with a 70 gram load applied to the leads for $3\,\pm\,1$ second.

Figure 12. Test #3



There shall be no deviation in the leads and no component leads shall be pulled free of the tape with a 500 gram load applied to the component body for 3 ± 1 second.

Figure 13. Marking for Reel/Ammo Pack

Figure 14. TO-92 Tape and Reel Shipping Container

Device Type_ _ Date Code _ Customer Part No. _ QA Lot No. _ _ Rev No. . Purchase Order No. _ Style _ Qty DATE Operator _ _ Inspector _

HEAVY DUTY WHITE CARBON LAYERED CORRAGATED SHIPPING BOX



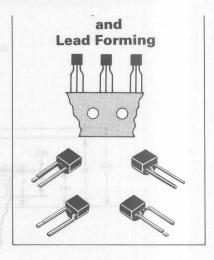
REEL MARKING LABEL DESICCATOR ANTISTATIC ZIPLOCK BAG

best methods of capturing devices for automatic insertion in printed circuit boards. These methods of taping are compatible with various equipment for active and passive component insertion.

- · Available on 365 mm Reels
- Available in Ammo Pack (Fan Fold Box)
- Accommodates Various Inserters
- Allows Flexible Circuit Board Layout
- 2.5 mm Pin Spacing for Soldering
- Conforms to EIA ACP Standard 1375 (RS-468)*

*EIA ACP reel diameter 360 mm. Motorola is 365 mm.

When ordering radial type ON REEL specify the style per Figure 4. Add the suffix to the device title, i.e. BC237ARL1. This will be a standard BC237A radial taped and supplied on a reel per RL1 option.

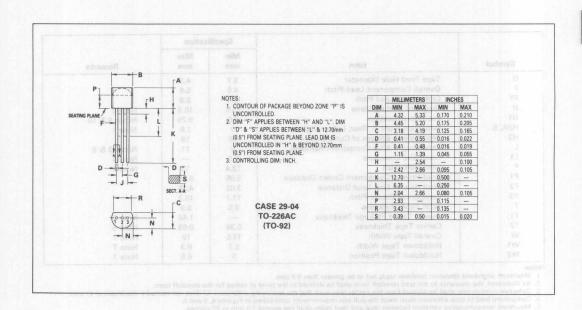


TO-92 Lead Forming

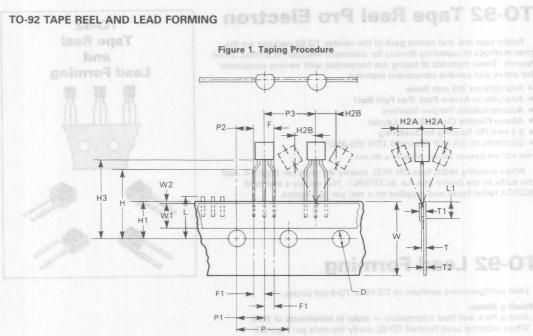
Lead configurations conform to TO-18 or TO-5 pin circles.

Ordering Notes:

Ammo Pack and Reel information — **order in increments of 2000.**When ordering Lead Formed TO-92, verify the style per Figure 8.



7

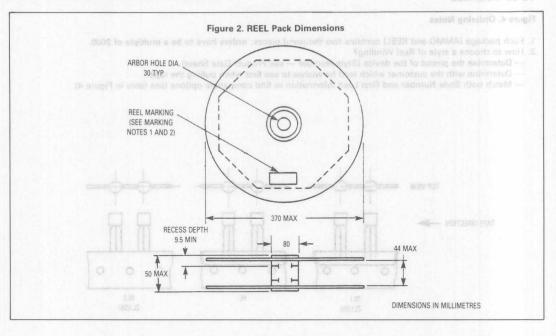


		Specif	ication	
Symbol	Item	Min mm	Max mm	Remarks
D	Tape Feed Hole Diameter	3.7	4.3	
F	Overall Component Lead Pitch	4.8	5.8	
F1	Component Lead Pitch	2.4	2.9	H-
H XX	Height of Seating Plane	15.5	16.5	Note 2
H1	Feed Hole Location	8.5	9.75	Notes 9 & 10
H2A, B	Deflection Front or Rear, Left or Right	8 0	1.0	Note 1
H3	Feed Hole to Bottom of Component	18	19	
L 915	Lead Length After Component Removal	0	11	Notes 3 & 8
L1	Lead Wire Enclosure	2.5	-	Note 4
P	Feed Hole Pitch	12.4	13	Note 5
P1	Feed Hole — Component Centre Distance	5.95	6.75	
P2	Feed Hole — First Lead Distance	3.02	4.35	
P3	Component Centre Pitch	11.7	13.7	F-1
T	Total Tape Thickness	0.5	0.9	
T1 36	Overall Taped Package Thickness	_	1.44	Note 6
T2	Carrier Tape Thickness	0.38	0.68	Note 6
W	Overall Tape Width	17.5	19	Note 7
W1	Holddown Tape Width	5.7	6.3	Note 7
W2	Holddown Tape Position	0	0.5	Note 7

- Maximum alignment deviation between leads not to be greater than 0.2 mm.
 As illustrated, the clearance to the lead standoff form shall be defined to the point of radius for the standoff form.
- Defective components shall be clipped from the carrier tape such that the remaining protrusion (L) does not exceed a maximum of 11 mm. Component lead to tape adhesion must meet the pull test requirements established in Figures 4, 5 and 6. Maximum non-cumulative variation between tape and feed holes shall not exceed 1.0 mm in 20 pitches.

 Overall taped package thickness, including component leads and tape splices shall not exceed 1.44 mm.

- Holddown tape not to extend beyond the edge(s) of carrier tape and there shall be no exposure of adhesive.
 No more than 3 consecutive missing components is permitted.
 A tape trailer having at least three feed holes is required after the last component.
 Splices shall not interfere with the sprocket feed holes.



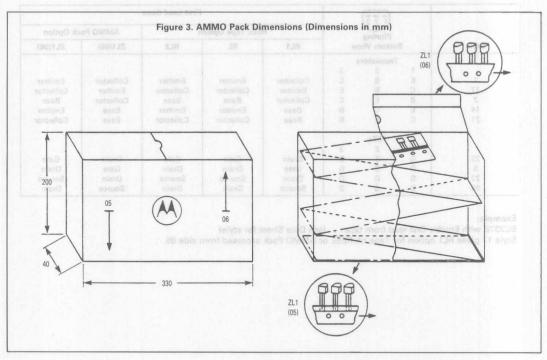
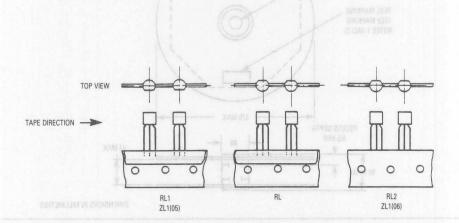


Figure 4. Ordering Notes

- 1. Each package (AMMO and REEL) contains two thousand pieces: orders have to be a multiple of 2000.
- 2. How to choose a style of Reel Winding?

 - Determine with the customer which lead he wishes to see first when pulling the tape.

 Match both Style Number and First Lead information to find compatible options (see table in Figure 4).



	-	(===)				First Lead Seen		
	-	1 2 3		man andizner	EEL Tape Optio	AMMO Pack Option		
Style	В	ottom Vie	w	RL1	RL	RL2	ZL1(05)	ZL1(06)
	123	Transistors	S					
	1	2	3					
111/	E	В	C	Collector	Emitter	Emitter	Collector	Emitter
17	C	В	E	Emitter	Collector	Collector	Emitter	Collector
2	В	E	C	Collector	Base	Base	Collector	Base
14	E	C	В	Base	Emitter	Emitter	Base	Emitter
21	С	E	В	Base	Collector	Collector	Base	Collector
1	1/20	FETs		7	1			77
	1	2	3		/	3		V 1 1
23	G	S	D	Drain	Gate	Gate	Drain	Gate
5	D	S	G	Gate	Drain	Drain	Gate	Drain
22	S	G	D	Drain	Source	Source	Drain	Source
30	D	G	S	Source	Drain	Drain	Source	Drain

Example:

BC237B with Emitter first lead from tape . . . (see Data Sheet for style)
Style 17 gives RL1 option for Tape on REEL or AMMO Pack accessed from side 05.





Figure 5. Adhesion Pull Test 100 GRAM PULL FORCE HOLDING FIXTURE The component shall not pull free with a 300 gram load applied to the leads for 3 ± 1 second.

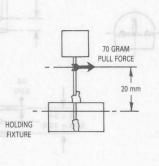
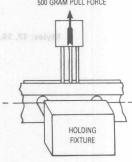


Figure 6. Adhesion Pull Test No. 2

The component shall not pull free with a 70 gram load applied to the leads for $3\,\pm\,1$ second.

500 GRAM PULL FORCE

Figure 7. Adhesion Pull Test No. 3



There shall be no deviation in the leads and no component leads shall be pulled free of the tape with a 500 gram load applied to the component body for 3 \pm 1 second.

Marking Notes:

- Minimum container and reel marking shall consist of the following items:
 - a. Motorola
 - b. Customer Purchase Order Number
 - c. Quantity
 - d. Date of Reeling
 - e. Motorola Part Number
- Where applicable, the following items will be included:
 - a. Customer Part Number
 - b. Device Date Code

TO-92 LEAD FORMING

Figure 8. Ordering Notes

How to choose Lead Form option:

- Determine option either TO-18 or TO-5, see Dimensional Drawings
 - *Identify measurement between centres of the two outside leads:
 - i.e. 2.5 mm for TO-18 5.0 mm for TO-5

- Determine the pinout of the device (Style Number see Product Data Sheet)
- 3. Identify Drawing corresponding to Style Number (see Figures 8a and 8b).

Example:

BC237B configured TO-18. . . .

See Data Sheet for Style Number

Style 17... Drawing indicates Dimensions, and that position of Centre Lead is towards the round side of the product (towards the back)

Order type: BC237B18

Other Examples:

P2N2222-18 P2N2222A18 2N5551-5 BC488A18 BC337-25-5 BC547C5

Note: For reverse configurations, please consult the factory.

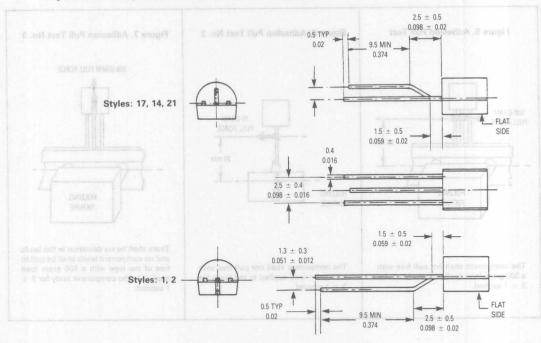
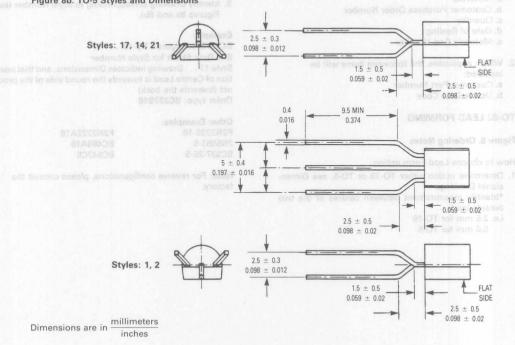
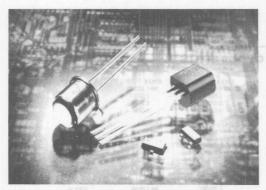


Figure 8b. TO-5 Styles and Dimensions



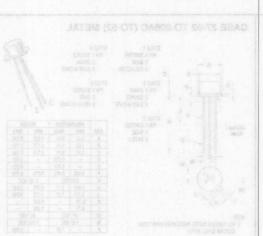


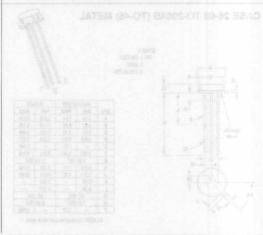
The following pages contain information on the various packages referenced on the individual data sheets. Information includes: a picture of the package, dimensions in both millimeters and inches, the various pinout configurations (styles), a cross reference for Case numbers, "old" JEDEC "TO" numbers, and the new JEDEC "TO" designation.

Additionally, abstracts of available application notes are provided. Please contact your local sales representative for those desired.



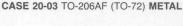
Package Outline Dimensions and Application Literature

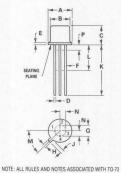




Package Outline Dimensions

Dimensions are in inches unless otherwise noted.





OUTLINE SHALL APPLY.

	MILLIM	ETERS	INC	HES
DIM	MIN	MAX	MIN	MAX
A	5.31	5.84	0.209	0.230
В	4.52	4.95	0.178	0.195
C	4.32	5.33	0.170	0.210
D	0.41	0.53	0.016	0.021
E	_	0.76	_	0.030
F	0.41	0.48	0.016	0.019
G	2.54	BSC	0.100	BSC
Н	0.91	1.17	0.036	0.046
J	0.71	1.22	0.028	0.048
K	12.70	-	0.500	-
L	6.35	-	0.250	-
M	45°	BSC	45°	BSC
N	1.27	BSC	0.050	BSC
P	-	1.27	-	0.050

CASE 20 STYLES

PIN 1. SOURCE 2. DRAIN PIN 1. SOURCE 2. GATE 1 3. GATE 4. CASE LEAD STYLE 2: STYLE 6: PIN 1. SOURCE 2. GATE PIN 1. DRAIN 2. SOURCE AND 3. DRAIN CASE LEAD PIN 1. DRAIN 2. SOURCE 3. GATE 4. CASE LEAD

PIN 1. DRAIN 2. SOURCE 3. GATE 4. CASE AND SUBSTRATE PIN 1. EMITTER 2 2. BASE 1 3. COLLECTOR 4. EMITTER 1

3. DRAIN

4. CASE

SUBSTRATE 3. GATE 4. SOURCE AND

SUBSTRATE

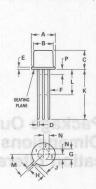
BASE 2

PIN 1. DRAIN 4. SOURCE. STYLE 10: PIN 1, EMITTER

2. BASE 3. COLLECTOR 4. CASE

2. CATHODE 3. COLLECTOR 4. ANODE

CASE 22-03 TO-206AA (TO-18) METAL



8



CASE 22 STYLES

STYLE 4: PIN 1. SOURCE

2. DRAIN 3. GATE AND CASE

PIN 1. SOURCE 2. GATE 3. DRAIN

4. GATE 2 -

SUBSTRATE AND CASE

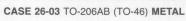
STYLE 1: PIN 1. EMITTER STYLE 6: PIN 1. CATHODE 2: BASE 3. COLLECTOR 2. GATE 3. ANODE STYLE 7: PIN 1. ANODE SUBSTRATE AND CASE 2. GATE BASE
 CATHODE 3. DRAIN STYLE 8: PIN 1. GATE STYLE 3: PIN 1. SOURCE 2. ANODE 1 3. ANODE 2 2. DRAIN 3. GATE

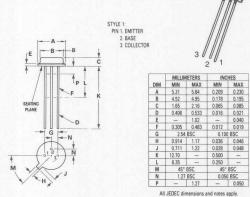
STYLE 9: PIN 1. ANODE 2 2. ANODE 1 3. GATE (CONNECTED TO CASE)

STYLE 10: PIN 1. BASE STYLE 5: PIN 1. EMITTER 2. EMITTER 3. BASE 2. BASE 1 3. BASE 2

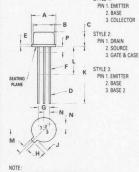


STYLE 11: PIN 1. DRAIN 2. SOURCE, STYLE 12: PIN 1. SOURCE 3. DRAIN (CASE) PIN 1. ANODE GATE
 CATHODE





CASE 27-02 TO-206AC (TO-52) METAL





2. DRAIN

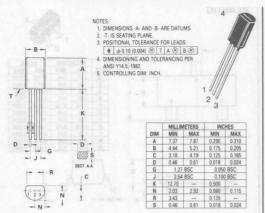
PIN 1. SOURCE 2. GATE

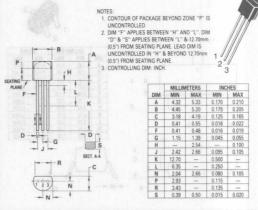
STYLE 5:

3. GATE & CASE

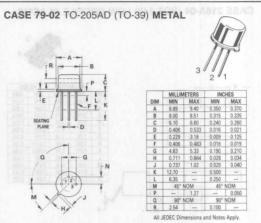
1. ALL RULES & NOTES ASSOCIATED WITH TO-52 OUTLINE SHALL APPLY.

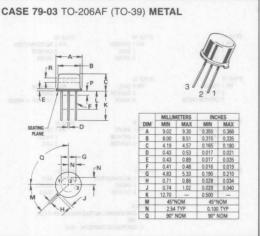


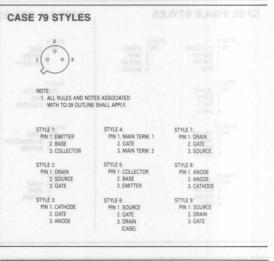


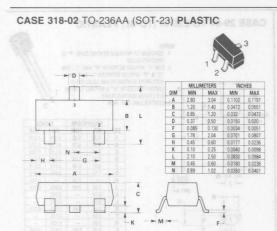


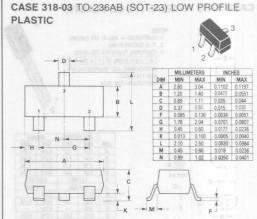


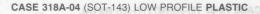


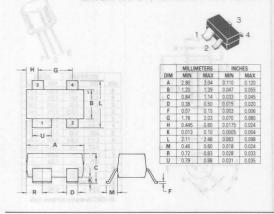


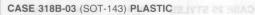


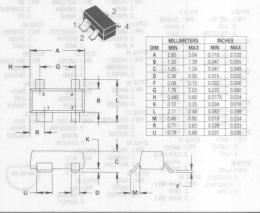












CASE 318A,B STYLES

8

STYLE 1:		STYLE 5:	
PIN 1.	COLLECTOR	PIN 1.	SOURCE
2.	EMITTER	2.	DRAIN
3.	EMITTER	3.	GATE #1
4.	BASE	4.	SOURCE
STYLE 2:			
PIN 1.	SOURCE		
2.	DRAIN		
3.	GATE 1		
4.	GATE 2		
STYLE 3:			
PIN 1.	GROUND		RET VILANG I
2.	SOURCE		
3.	INPUT		
4.	OUTPUT		
STYLE 4:			
	OUTPUT		
	GROUND		
	GROUND		
	INPUT		
*	TALLE ! HE		

CASE 318 STYLES

STYLE 6:		STYLE 10	
PIN 1	BASE	PIN 1. DRAIN.	
	EMITTER	2 SOURCE	
3.	COLLECTOR	3. GATE	
STYLE 7:		STYLE 11:	
	EMITTER	PIN 1. ANODE	
2.	BASE	2. CATHODE	
3.	COLLECTOR	3. CATHODE-A	NODE
070000		20000	
STYLE 8:		STYLE 12	
PIN 1.		PIN 1. CATHODE	
3236 2	NO CONNECTION	2. CATHODE	
3.	CATHODE	3. ANODE	
STYLE 9		STYLE 13	
	ANODE	PIN 1 SOURCE	
	ANODE	2 DRAIN	
	CATHODE	3. GATE	
2	UATHOUE	J. GAIL	

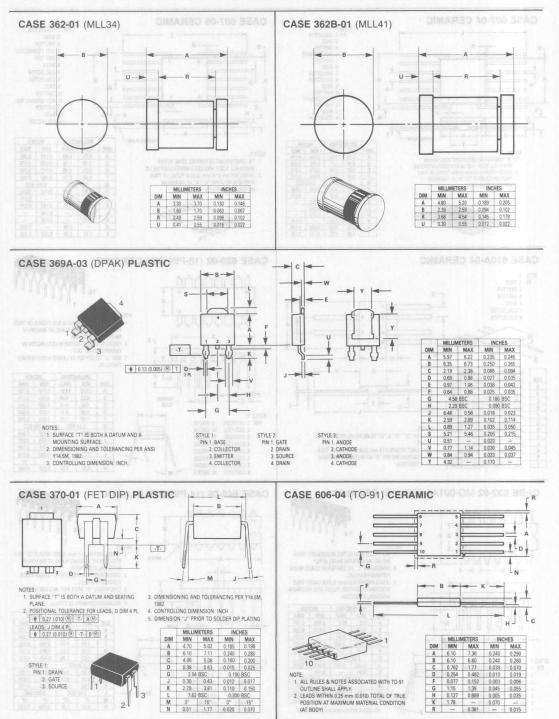
STYLE 14: PIN 1. CATHODE 2. GATE 3. ANODE	STYLE 18: PIN 1. NO CONNECTION 2. CATHODE 3. ANODE
STYLE 15: PIN 1. GATE	STYLE 19: PIN 1. CATHODE
2 CATHODE 3 ANODE	2. ANODE 3. CATHODE — ANODE

PIN 1. CATHODE 2. CATHODE 3. ANODE			ANODE CATHODE CATHODE	PIN 1. CATHODE 2. ANODE 3. GATE	
3. ANOUE		9	CATHODE	3. GAIE	
PIN 1 SOURCE			NO CONNECTION	STYLE 21: PIN 1. GATE	

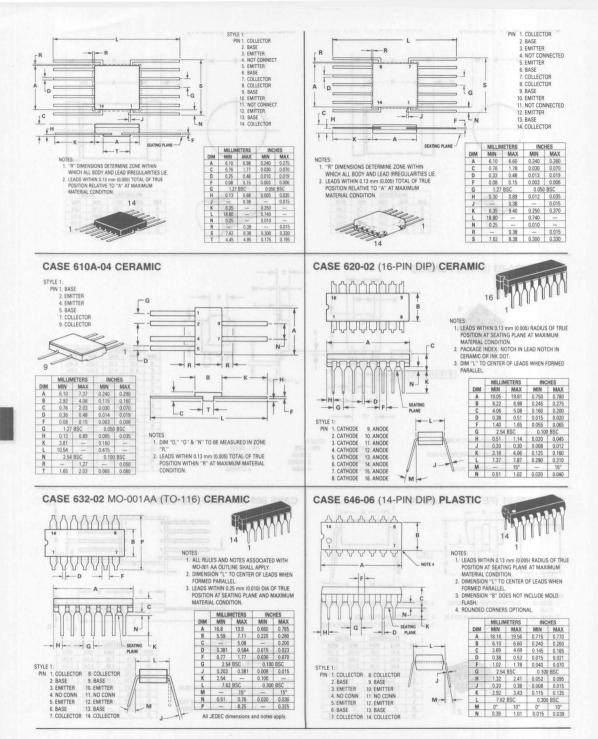
2 ANUDE 2 SOUNCE
3 CATHODE 3 DRAIN

NOTES:
1. DIMENSIONING AND TOLERANCING PER Y14.5M,
1882
2. CONTROLLING DIMENSION: INCH.

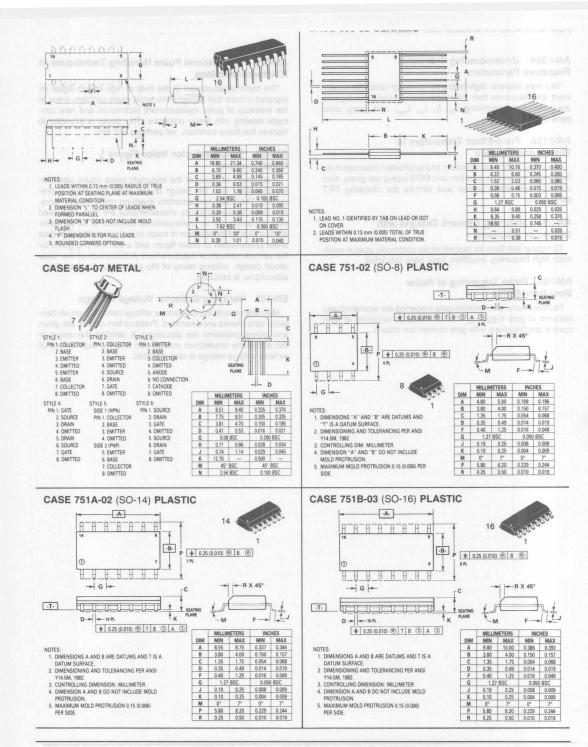
MOTOROLA SMALL-SIGNAL SEMICONDUCTORS











(Application Notes are available upon request.)

AN-139A Understanding Transistor Response Parameters

This note explains high-frequency transistor response parameters and discusses their interdependence. Useful nomograms are given for determining $h_{\rm fe},~f_{\rm T},~f_{\alpha e},~f_{\rm max},~$ and many other parameters.

AN-211A Field-Effect Transistors in Theory and Practice

The basic theory, construction, and application information for field-effect transistors (junction and MOS types) are given. Also included are some typical test circuits for checking FET parameters.

AN-267 Matching Network Designs with Computer Solutions

Computer solutions for four networks commonly used in solidstate high frequency amplifiers have been tabulated.

AN-268 Pulse Triggering of Radar Modulator SCR's

Factors involved in dynamic gate triggering are examined and relations of gate triggering characteristics to variations of total current amplifications with gate current are shown.

AN-270 Nanosecond Pulse Handling Techniques in IC Interconnections

The rapid advancement in the field of high speed digital integrated circuits has brought into focus many problem areas in the methods of pulse measurement techniques and new concepts dealing with these problems. This paper is intended to discuss the more common, yet perhaps not well

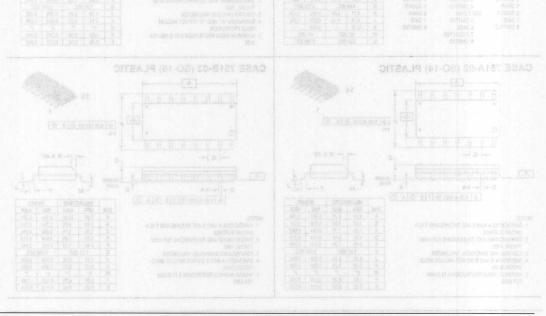
AN-421 Semiconductor Noise Figure Considerations

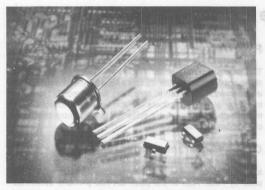
A summary of many of the important noise figure considerations related with the design of low noise amplifiers is presented. The basic fundamentals involving noise, noise figure, and noise figure-frequency characteristics are then discussed with the emphasis on characteristics common to all semiconductors. A brief introduction is made to various methods of data sheet presentation of noise figure and a summary is given for the various methods of measurement. A discussion of low noise circuit design, utilizing many of the previously discussed considerations, is included.

EN-101 Verifying Collector Voltage Ratings

Methods of verifying the various voltage ratings given on transistor data sheets are described. Practical test circuits are given and testing problems are discussed. A detailed discussion of the avalanche breakdown mechanism and the significance of various voltage ratings is also included.

8





Discrete products are available from Motorola in three quality levels: Industrial/Commercial grade, Military grade, and Customer Specials.

This Reliability and Quality Assurance section contains information on final test and quality assurance processing. Included is a listing of Q.A. tests and the applicable MIL-STD methods relating to the above-noted quality levels.

High reliability (JAN, JANTX, JANTXV, and JANS) processing of transistors is outlined by using a processing and quality control flow chart.

A glossary of Reliability and Quality terms is also included.

Reliability and Quality Assurance

Quality Levels

Most small-signal discrete products are available from Motorols in three quality levels:

INDUSTRIAL COMMERCIAL GRADE — identified by a part number prefix such as 2N, MM or MPS and tested to a published Motorols, JEDEC or Proviscitor

MILITARY GRADE — Identified by a 2N part number orefix, a JAN, JTX, JTXV or JANS suffix, and manufacture and transfer over IMI 5-10600

TXX — Same as JAM plus 198% processing
JYXV — Same as JTX plus 198% internal visual

JANS -- Same as JTXV plus water tot acceptance and additional 100% processing requirements:

ing as determined by the customer to meet his particular requirements. This may range from a custom-marked inclustrial commercial grade product for a th-rel product which is subjected to a series of shingent inspections and tests to meet senspace or special military aquirements.

TABLE 1 - 100% PRECONDITIONING AND SCREENING (Example of SN2222A Fem

	Consisson		
	00 on - 00		
	200°C, 24 hours		
	C, 20 cycles		
	19,000 G. Y1		
	8		
Reliability an			
	H 10 0		
Quality Assuranc	A.C. E or P		
Quality Assurance	read & record		
	150°C, 48 hours		
	"intecen & been !		
	25°C, 188 mours		
	25°C, 246 hours		
	"history & bash"		
	H to B		
	A.C. E or F		

IOTOROLA SMALL-SIGNAL SEMICONDUCTORS

- INDUSTRIAL/COMMERCIAL GRADE Identified by a part number prefix such as 2N, MM or MPS and tested to a published Motorola, JEDEC or Proelectron specification.
- MILITARY GRADE Identified by a 2N part number prefix, a JAN, JTX, JTXV or JANS suffix, and manufactured and tested per MIL-S-19500.
 - JAN Controlled lot with sample environmental and life testing
 - JTX Same as JAN plus 100% processing
 - JTXV Same as JTX plus 100% internal visual inspection
 - JANS— Same as JTXV plus wafer lot acceptance and additional 100% processing requirements.
- CUSTOMER SPECIAL Screening, testing and marking as determined by the customer to meet his particular requirements. This may range from a custom-marked industrial/commercial grade product to a hi-rel product which is subjected to a series of stringent inspections and tests to meet aerospace or special military requirements.

Device lots are subjected to 100% processing in Final Test. This processing may be as simple as electrical testing to data sheet specifications or as complex as a series of mechanical, environmental and burn-in screening tests preceded and followed by electrical readouts. All lots, whether industrial/commercial, military or hi-rel, are subjected to a minimum eight-hour storage bake at 150°C or 200°C.

Quality Assurance Processing

All products are transferred to QA where they are subjected to Group A electrical testing, usually to the same specifications used by Final Test. In the past, QA has primarily performed sample testing; but now, at Motorola, most small-signal metal can transistors are 100% electrical tested by QA, and when this expansion program is completed, all small-signal transistors will be subjected to 100% QA electrical testing. Military and hi-rel lots may undergo additional 100% screening in QA. Using the popular 2N2222A family as an example, Table 1 compares the varying degrees of preconditioning and screening that are done on the 2N2222A, 2N2222AJAN, 2N2222AJTX, 2N2222AJTXV and 2N2222AJANS transistors. QA randomly selects test samples for Group A, B and C testing as defined in MIL-S-19500. The individual tests are defined in MIL-STD-750. Tables 2 and 3 list the Group B and C test requirements for the 2N2222A military family.

TABLE 1 — 100% PRECONDITIONING AND SCREENING (Example of 2N2222A Family)

Test		MIL-STD-750 Method	Condition	2N2222A 2N2222AJAN	2N2222AJTX 2N2222AJTXV	2N2222AJANS
1.	Electrical tests		go – no go	100%	100%	100%
2.	High temperature storage	1032	200°C, 24 hours		100%	100%
3.	Thermal shock	1051	C, 20 cycles	-0.5	100%	100%
4.	Constant acceleration	2006	20,000 G, Y1		100%	100%
5.	Particle impact noise	2052	В	_	<u> </u>	100%
6.	Hermetic seal					
	fine leak	1071	G or H	_	100%	100%
	gross leak	1071	A, C, E or F		100%	100%
7.	Electrical tests		read & record			100%
8.	H.T. reverse bias	1039	150°C, 48 hours	_	100%	100%
9.	Electrical tests	_	read & record*		100%	100%
10.	Full-power burn-in	1039	25°C, 168 hours	_	100%	-119
11.	Full-power burn-in	1039	25°C, 240 hours		_	100%
12.	Electrical tests		read & record*		100%	100%
13.	Hermetic seal					
	fine leak	1071	G or H		100%	100%
	gross leak	1071	A, C, E or F		100%	100%
14.	X-ray	2076	_			100%
15.	External visual	2071	_			100%

^{*}Bin & cell may be used for JTX and JTXV product

Inspection or Test	are per-	MIL-STD-750 Method	Condition	LTPD (Accept No.) and Military Classification
SUBGROUP LTPD Physical dimensions			elec- (1) Wire put	10 (0) JANS
SUBGROUP LTPD	gniqqaari		in the Units are stone	near, they are se (1) 15 separated to for
Solderability		2026		ALL soib tau bivit
Solvent resistance		1022		ALL
SUBGROUP LTPD	FLOW CHART		PROCESSING AND G	10 (1)
Thermal shock		1051	C1, 25 cycles	JAN, JTX, JTXV
Thermal shock		1051	C3, 100 cycles	JANS
Hermetic seal				
fine leak		1071	G or H	ALL
gross leak	YISWBERA	1071	A, C, E or F	JATOREMALL
Decap internal visual	1. Jennagon	2075	DVISSEDOR	JANS
Bond strength		2037	A	JANS
Die shear	Service production production	2017	er den in compression particular des con-	JANS
SUBGROUP LTPD	A A		SWAC	5 (2)
Operating life	JANES	1027	25°C, 340 hours	JAN, JTX, JTXV
SUBGROUP LTPD			Lant.	20 (0)
Decap internal visual		2075		JAN, JTX, JTXV
Bond strength		2037	A	JAN, JTX, JTXV
SUBGROUP LTPD			VXTSIAL	35A90 Y9A110 (2)
Intermittent operating life		1037	25°C, 2000 cycles	JANS
SUBGROUP LTPD				10 (2)
Accelerated operating life		1027	125°C, 96 hours	JANS
SUBGROUP LTPD				7 (2)
High-temperature storage life		1032	200°C, 340 hours	JAN, JTX, JTXV

TABLE 3 — GROUP C TESTS (Example of 2N2222AJAN/JTX/JTXV/JANS)

Inspection or Test		MIL-STD-750 Method	Condition	LTPD (Accept No.) and Military Classification
SUBGROUP LTPD Physical dimensions	ончев Раосевчио	2066	=*Gasebon	15 (1) A ROPETO E ALLE ROS RV
SUBGROUP LTPD Thermal shock Terminal strength Hermetic seal fine leak gross leak Moisture resistance External visual	marking as determined at his particular require- from a custom-intaled first product that is sub- gent tests for acrospace	1056 2036	mehy requires 1/20, mer A Ilion step (By Indy occurry	10 (1) ALL ALL ALL ALL ALL ALL ALL
SUBGROUP LTPD	IX 100% LOW POWER	JAUSIV BIO AS	VIII 190% HIGH POWN	10 (1)
Shock Shock		2016	1500G	
Variable-frequency vibration		2056	100-2000 Hz	ALL
Constant acceleration			20,000 G	
SUBGROUP LTPD	dia placement and proc		in as seratohes, voxels, a	15 (1)
Salt atmosphere	lead wires must have progressional be progressional.		A memnum bits grigo strice as double another	
SUBGROUP LTPD	condition. Package det-		loted	10 (1)
Operating life	stem opiatot tot grikberto	1026	25°C, 1000 hours	ALL

I WAFER PROCESSING

After wafers are processed, they are subjected to Motorola visual inspection requirements and overlay geometry wafers are subjected to a sample SEM inspection to assure good step coverage. The wafers are then probed to electrical requirements and the rejects are inked. Finally, they are sawn and separated to form the individual dice.

II ASSEMBLY

The die are attached to headers and then wire bonded. The following mechanical tests are performed by Quality Control inspectors on a sample basis to ensure assembly process controls.

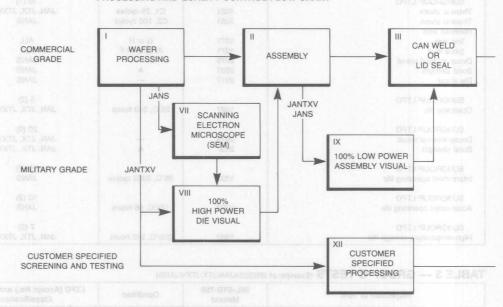
- (1) Wire pull tests
- (2) Die push off tests

Units are stored in dry air until ready for capping.

III CAN WELD OR LID SEAL

Completed headers are loaded into a vacuum chamber for can weld or processed thru a furnace for top attachments on ceramic packages. All devices are subjected to a high temperature storage (stabilization bake) prior to final electrical test.

PROCESSING AND QUALITY CONTROL FLOW CHART



VII SCANNING ELECTRON MICROSCOPE

All JANS product with overlay geometry requires a SEM inspection per MIL-STD-750, method 2077. To assure good metallization step coverage, Motorola monitors all overlay geometry transistor wafer lines whether or not it is required.

XII CUSTOMER SPECIFIED PROCESSING

Screening, testing and marking as determined by the customer to meet his particular requirements, which may range from a custom-marked standard product to a hi-rel product that is subjected to the most stringent tests for aerospace or military applications.

VIII 100% HIGH POWER DIE VISUAL

The high power portion of the inspection is performed to assure good die construction and front metal conditions. Individual reject criteria includes the following: Metallization defects such as scratches, voids, corrosion, adherence, bridging and alignment. Poor die construction conditions such as oxide and faults are also rejected.

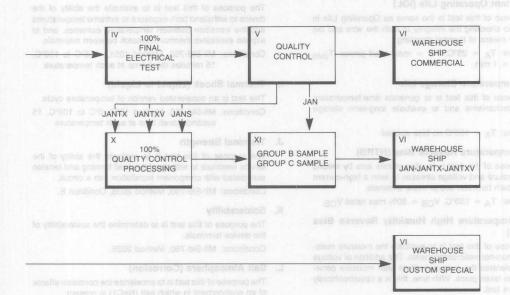
IX 100% LOW POWER ASSEMBLY VISUAL

The low power visual inspection controls work-manship, i.e., die attachment, internal lead-wire attachment, and package defects. Die attachment inspection includes assuring good watting, die placement and proper orientation. Internal lead wires must have proper arc and all attachment bonds must be properly placed and in good condition. Package defect inspection includes checking for foreign material, improper construction and cracked feedthroughs.

Completed devices are subjected to 100% testing to electrical requirements. When different devices are sourced from a single product line, they are sorted for voltage and gain.

Although it has been traditional for QA to perform sample testing, today most small-signal metal can transistors are 100% electrical tested by QA. Soon, all transistors will be 100% tested by QA. Group A and B tests are performed on JAN devices. Group A and B tests and 100% processing are performed on JANTX, JANTXV and JANS devices. Group C testing is required on a periodic basis.

Upon completion, the finished product is ready for shipping. Purchase order requirements are carefully checked again prior to shipping. Warranty tests (Group A) are performed every 24 months on military devices.



X 100% QUALITY CONTROL PROCESSING

- a. High-temperature storage
 - b. Thermal shock
 - c. Constant acceleration
 - d. Particle impact noise (JANS)
 - e. Hermetic seal
 - f. High-temperature reverse bias
 - g. Full-power burn-in
 - h. X-ray (JANS)
 - External visual (JANS)
 - . Read and record parameters

XI GROUP B AND GROUP C INSPECTION

Typical Group B Processing

- a. Physical dimensionsb. Solderability
- c. Solvent resistance
- d. Thermal shock
- e. Hermetic seal
- f. Decap internal visual
- g. Bond strength
- h. Die shear
- i. 340 hr. operating life
- j. Intermittent operating life (JANS)
- k. Accelerated operating life (JANS)
- I. 340 hr. storage life

- Typical Group C Processing
- a. Physical dimensions
- b. Thermal shock
- c. Terminal strength
- d. Hermetic seal
- e. Moisture resistance
- f. External visual
- g. Shock
- h. Variable-frequency vibration
- i. Constant acceleration
- j. Salt atmosphere
- k. 1000 hr. operating life

A. Steady State Operating Life (SSOL)

The purpose of this test is to evaluate the bulk stability of the die and to generate defects resulting from manufacturing aberrations that are manifested as time and stress-dependent failures.

Conditions: TA = 25°C, PD = max rated power

B. Intermittent Operating Life (IOL)

The purpose of this test is the same as Operating Life in addition to checking the integrity of both the wire and die bonds by means of thermal stressing.

Conditions: $T_A = 25^{\circ}C$, PD = max rated power. $T_{(on)} = T_{(off)} = 1$ min.

C. High Temperature Storage Life

The purpose of this test is to generate time/temperature failure mechanisms and to evaluate long-term storage stability.

Conditions: TA = 150°C no bias applied

D. High Temperature Reverse Bias (HTRB)

The purpose of this test is to align mobile ions by means of temperature and voltage stresses to form a high-current leakage path between two or more terminals.

Conditions: T_A = 150°C, V_{CB} = 80% max rated V_{CB},

E. High Temperature High Humidity Reverse Bias (H³TRB)

The purpose of this test is to evaluate the moisture resistance of non-hermetic components. The addition of voltage bias accelerates the corrosive effect after moisture penetration has taken place. With time, this is a catastrophically destructive test.

Conditions: $T_A = 85^{\circ}C$, RH = 85%, $V_{CB} = 80\%$ max rated V_{CB} ,

F. Moisture Resistance

The purpose of this test is to evaluate the moisture resistance of components under temperature/humidity conditions typical of tropical environments.

Conditions: Mil-Std-750, Method 1021.

G. Pressure Cooker

The purpose of this test is to evaluate the moisture resistance of non-hermetic components under pressure/temperature conditions.

Conditions: T = 121°C, P = 1 atmosphere (15 psig)

H. Temperature Cycle (Air to Air)

The purpose of this test is to evaluate the ability of the device to withstand both exposure to extreme temperatures and the transition between temperature extremes, and to expose excessive thermal mismatch between materials.

Conditions: Mil-Std-750, Method 1051, -55°C to 150°C, 15 minutes dwell time at each temperature

I. Thermal Shock (Liquid to Liquid)

This test is an accelerated version of temperature cycle.

Conditions: Mil-Std-750, Method 1056, 0°C to 100°C, 15 seconds dwell time at each temperature

J. Terminal Strength

The purpose of this test is to evaluate the ability of the device terminals to withstand the lead forming and tension associated with component installation into a circuit.

Conditions: Mil-Std-750, Method 2036, Condition E.

K. Solderability

The purpose of this test is to determine the solderability of the device terminals.

Conditions: Mil-Std-750, Method 2026.

L. Salt Atmosphere (Corrosion)

The purpose of this test is to accelerate the corrosion effects of an environment in which salt (NaC1) is present.

Conditions: Mil-Std-750, Method 1041

M. Mechanical Stress Tests

Vibration, shock and constant acceleration tests are infrequently used since they rarely generate failures in small-signal transistors. However, they are still specified for acceptance of military product.

Glossary of Reliability and Quality Terms

Acceptable Quality Level (AQL) — A measure of quality for which a given lot will be accepted most of the time. This is usually established at a probability of acceptance equal to 95%. It is referred to as the producer's risk because the probability of rejecting a good lot is 5%.

Acceptance Number (Ac) — The largest number of defectives in an inspection sample under consideration that will permit acceptance of the lot.

Acceptance Tests — Tests to determine conformance to specification requirements as a basis for lot acceptance.

Average Outgoing Quality (AOQ) — The average quality of outgoing product after 100% screening of rejected lots. This is usually measured in parts per million (PPM).

Average Outgoing Quality Limit (AOQL) — The maximum average outgoing quality that is possible for a given sampling plan.

Defect — Any deviation of a device that does not conform to specified requirements. One device may contain more than one defect.

Defective - A device which contains one or more defects.

Double Sampling — Sampling inspection in which the inspection of the first sample leads to a decision to accept, to reject, or to take a second sample. The inspection of a second sample, when required, always leads to a decision to accept or to reject.

Failure — The inability of a device to perform a specified function within previously-established limits.

Failure Rate — The statistical probability of a failure occurring within a stated period of time. For electronic components it is usually assumed that failures follow an exponential distribution, in which case the failure rate over any stated period of time is constant. The failure rate of semiconductor devices is generally given in percent per thousand hours.

Infant Mortality — Premature failures occurring at a failure rate substantially greater than that observed during subsequent life prior to wear-out.

 ${\bf Lot}$ — A group of devices from which samples are drawn and inspected to determine compliance with acceptance criteria (inspection lot).

Lot Tolerance Percent Defective (LTPD) — A measure of quality for which a given lot will be rejected most of the time. This is usually established at a probability of acceptance equal to 10%. It is referred to as the consumer's risk because the probability of accepting a bad lot is 10%.

Mean Time Between Failures (MTBF) — The total measured operating time of a group of equipments divided by the total number of failures of a repairable equipment. In the case of an exponential failure distribution, this ratio is the reciprocal of failure rate.

Operating Characteristic Curve (OC curve) — A graph of the probability of acceptance as a function of the lot quality or process average quality, whichever is applicable.

Percent Defective — The number of defective devices in a lot divided by the total number of devices in that lot, multiplied by 100.

Probability of Acceptance (Pa) — The fractional probability that a lot will be accepted, usually expressed as a decimal.

Process Average Quality — The expected quality of product from a given process, usually estimated from first sample results of previous inspection lots.

Quality — A measure of the degree to which a product conforms to specification and workmanship requirements.

Rejection Number (Re) — The smallest number of defectives in an inspection sample under consideration that will prevent acceptance of the lot.

Reliability — A measure of the performance of a product over a specified period of time.

Sample — One or more devices selected at random from an inspection lot to represent that lot for acceptance purposes.

Sampling Plan — A specific plan which defines the sample size and the criteria for accepting or rejecting a lot.

Screening Tests — Tests employing nondestructive environmental, electrical, thermal and/or mechanical stresses, for the purpose of identifying anomalous devices.

Single Sampling — Sampling inspection in which a decision to accept or to reject is reached after the inspection of a single sample.

Wearout Failures — Those failures which occur as a result of deterioration processes and whose probability of occurrence increases with time.

100% Inspection — Inspection of every device, in which each device is accepted or rejected individually for the characteristic concerned, on the basis of its own inspection only.

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